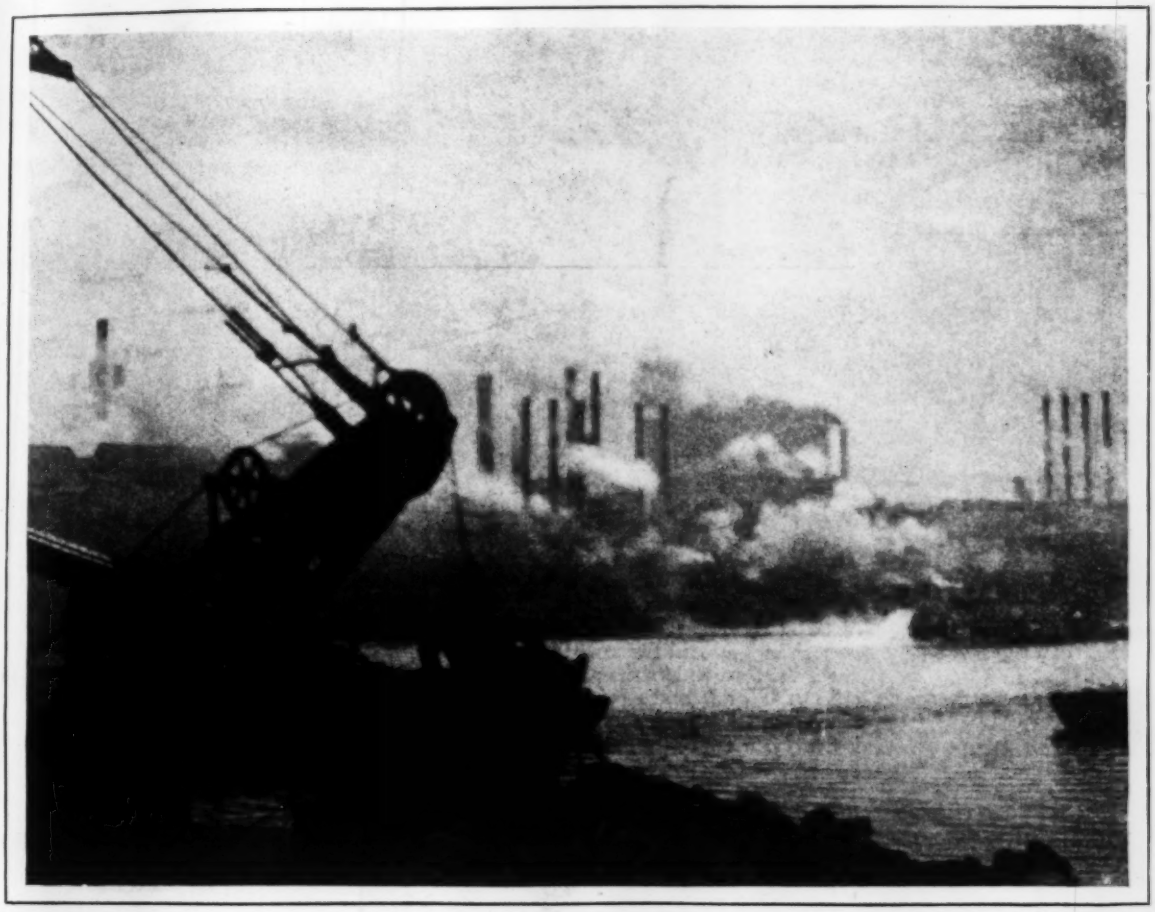
AUG 25 1923

Engineering News-Record

McGraw-Hill Company, Inc. Devoted to Civil Engineering and Contracting

August 23, 1923



"Romance of Industry"

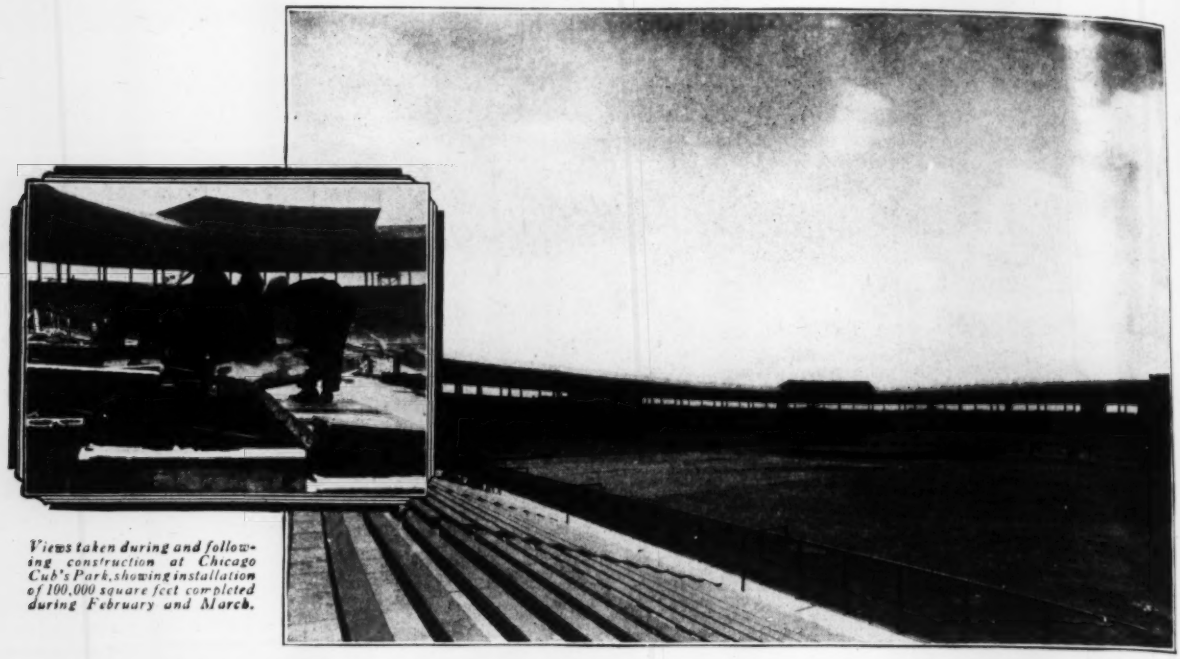
From a photograph by O. C. Reiter
President of the Pittsburgh Salon

How an Oklahoma Dam Withstood June Floods

Steel Forms Successful on Concrete Job

Two Articles on Fatigue in Metals

"From Job and Office"



Views taken during and following construction at Chicago Cub's Park, showing installation of 100,000 square feet completed during February and March.

FEDERAL Cement Tile

—*in the baseball line-up this year*

The first call of "batteries for today's game" found Federal Cement Tile playing an important position at the Chicago National League [Cubs] Baseball Park. Flat slabs are used for stepped flooring under the seats and in the aisles—an excellent use for Federal Roof Slabs because it will stand the continued walking, standing, and jumping of thousands of pairs of feet year after year.

By installing Federal Pre-Cast Slabs it was possible to rush the work through the winter months uninterrupted by cold weather and snow—which would have been impossible if poured concrete were used. Moreover the use of Federal Roof Tile insured a lighter, stronger, more uniform covering.

The unqualified success of this installation—and hundreds of others—is of course the direct result of unmatched manufacturing facilities and long experience.

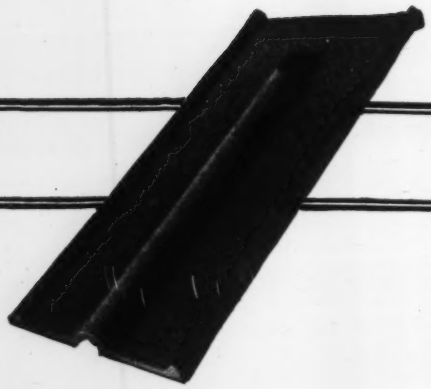
Federal Tile, for all flat and pitched surfaces is made in the natural concrete and oxidized [red] colors, with and without glass inserts.

Made, Laid and Guaranteed by

FEDERAL CEMENT TILE CO.

110 So. Dearborn St., Chicago

Works: Hammond, Ind. and Detroit, Mich.



"The Roof for Permanence"

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, *President*

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, *Editor*
FRANK C. WIGHT, *Managing Editor*

Volume 91 — NEW YORK, AUGUST 23, 1923 — Number 8

Has the Public Control?

THE negotiations between the coal miners and operators now in progress at Atlantic City will demonstrate as never before whether public opinion is an effective force in the settlement of labor disputes. The people, generally speaking, have not taken sides in this controversy; few outside those directly concerned know anything about the issues involved. What the mass of the people do know is that anthracite coal, hitherto a necessity for a considerable and important part of the country, is controlled absolutely by half-a-dozen men sitting around a table at a beach hotel. On their ability to agree rests the comfort and health of many millions of American citizens. These citizens, we believe, are agreed that the questions in dispute are arbitrable and they expect them to be settled but, having in mind the hardships of last winter, they are willing that the government, through the President, go to any means, however extreme, to force the production of anthracite in the event that those in control cannot agree. Within a week we shall see whether Mr. Lewis and Mr. Warriner are willing to force the coal business into government control.

The Ruhr Deadlock

HOWEVER much one sympathizes with the French effort to extract proper reparation from the Germans the impression grows that the occupation of the Ruhr is a failure, unless it is a preliminary to annexation, though how any Frenchman can desire such annexation with the memory of Alsace-Lorraine and its fifty years of "revenge" in mind is more than the boundary-secure American can imagine. As an industrial move, however, the French policy is playing into German hands. For a certain length of time—no one knows how long—the Germans can continue to refuse to produce and can concentrate all their effort on permanent improvements, which will return increased revenues when, or if, they ever get back control of their own industry. The deadlock grows—but with it grows the feeling that the whole reparations question must be taken out of the hands of the statesmen, or politicians (which is a more exactly defining word), and turned over to an international group of business men to settle.

Speeding-up Through Motor Traffic

ONE WAY of solving the problem of traffic congestion in small cities and towns is suggested by M. O. Eldridge, executive chairman of the American Automobile Association, after an inspection trip in the New England States. Mr. Eldridge says: "Oftentimes through a careful study of the traffic situation a route through the town can be selected which will avoid the heavily congested streets. The route selected may not be the most direct and may require the use of a number of different streets. However, if the route is plainly marked, tourists will use it in preference to stopping at corners and inquiring their way. The situation found in some of the cities and towns in the New England States can be duplicated all over the country. The impression which a well laid out and well marked route through town will make on the visiting motorist will amply repay any community for the study and effort required to bring it about. A tourist never fails to advertise a town where he found it easy to get in and out again." This recommendation is similar to that made in the editorial review of the traffic situation in *Engineering News-Record*, June 21, 1923, p. 1070. The success of the method in towns where it has been tried has been so general that most towns and cities will do well to make a special study of this feature and see if they can outline a route that will divert through traffic from their over-congested streets.

Federal Contract Provides Arbitration

A DECIDED advance in the equities of contractual relations is marked by the decision of the Interdepartmental Board of Contracts and Adjustments to provide an arbitration clause in federal government construction contracts. In these contracts in the past there has been no appeal from the decision of the contracting officer. Now the right of appeal to department heads is extended in matters of time and of the financial consideration involved. Coming from the stronghold of drastic contracts and exacting supervision this concession of arbitration privileges assumes almost an epochal significance. It should stimulate action, long delayed, by a number of engineering associations which now have arbitration clauses before them for consideration.

Too Much Standardization

EX-PRESIDENT Eliot of Harvard, in a recent letter to the New York *Times*, deplores the current craze for standardization as a deadening influence on social development. In particular, he is concerned with the evil effects on a proper individualism which will result, he thinks, from our growing standardization of the worker's operations. It is a fair question whether this phase of the standardization evil is not being overemphasized. Is it a fact that the worker is more deadened by eight hours of one operation than by twelve or more hours of varied tasks? The man in the story who said that his qualifications for a machinist's job were that he had spent three years tightening the right forward holding-down bolt on Ford engines doubtless did not get as much out of his work as did the mechanic who built Stephenson's locomotives, but certainly he sees more and enjoys more in his sixteen daily hours away from the shop than did his predecessor in the ten or twelve which he had for leisure and sleep. This world can never return to the individual artisan. The

best that can be done is to move toward an amelioration of working and living conditions and an increase of leisure and pay which will make up for the loss in the joy of the work itself. At the same time, Dr. Eliot does well to sound a warning that standardization is not the ultimate ideal in every phase of life, which is a too general tendency especially in technical circles. The distinction between simplification of style and pattern and complete standardization is too little appreciated. It is eminently desirable to have the sizes and shapes of steel I-beams reduced to a minimum. It would be a most restrictive binder on engineering initiative to insist on the establishment of a few standard types of bridges. And yet just this latter kind of thinking is apt to result from the glorification of the standardization idea.

State Supply of Road Materials

BOLD seizure of the road-building materials supply situation is apparently contemplated by the Missouri State Highway Commission. A month ago the announcement was made that the commission would receive bids for furnishing, for one or several years, all cement required, or, as an alternative, for providing the state with one or two cement manufacturing plants. On Sept. 5, it is now announced, the commission will receive bids for furnishing for one year or for a term of years, all sand, gravel and crushed stone required for road construction. Except that Missouri contemplates supplying all materials and not cement alone its plan is not different than that in force for some years in Illinois. Its threat to operate state cement mills is nothing different than is being threatened by half a score of states. The significance of the present action is that it indicates the hardening will of state highway administrations to rid themselves of the obstacles of alleged unfair prices, insufficient production and uncertain transportation of road-building materials. Virtually it is an attempt to stabilize for road construction the materials market. There is precedent for state purchase and supply of road-building materials. Apparently the practice has been satisfactory. The uncertain venture is state manufacture of cement. Opinion of some of its complexities was given in the issue of March 22, 1923, p. 519, and nothing has since occurred which materially modifies that opinion. The vision of state manufacture, as a certain means of relief from present difficulties of cement supply, will not, however, be dispelled by anything that anyone can say. The plan has to be tried out. Perhaps Missouri will be the state which will undertake the experiment. It is certain, if it does, that a number of other states will form an interested audience.

Amateur Engineering Again

FROM California there comes a story of amateur engineering which fortunately had no sequel of toll of life or injury, though it did involve sufficient loss of money to make it a good example of how not to do engineering work. A man who owned a large ranch in Humboldt County, near Eureka, not conveniently accessible to the rest of the county, succeeded in getting through a county appropriation for the construction of a 280-ft. span bridge under designs prepared by a local "engineer" in no wise qualified to undertake such work. The bridge was built and the ranch sold, after which the chief actor in the incident lost all interest in the structure. The superstructure of the bridge was of simple suspension design and seems to have been quite satisfactory, but the piers were founded on soft material and when the rainy season came they began to slip and slide. One of them moved down the channel and partly tipped over. The county had expended $25,000 on this bridge, and when it threatened to disappear in the river the county authorities called in a competent local construction company with emergency orders to salvage as much of the bridge as possible. This company went in and took down the entire superstructure and stored it for the winter or at least pending the reconstruction of proper piers. Possibly when they put back the bridge the county will think that a regular engineer will pay. Such an engineer can design a movable bridge; it takes one of his amateur imitators to design a removable one.

An Explanation Which Does Not Explain

DR. WORK'S explanation of the reasons for his removal of Arthur P. Davis from the Reclamation Service, as given in his letter to the American Society of Civil Engineers, is only a repetition, over his own signature, of the views that have been credited to him in interviews. To be completely understood, however, it should be read along with the "memorandum for the press," just issued by the Department of the Interior and reproduced along with the letter in the news section of this issue. The letter and the memorandum taken together make a fair prospectus of the campaign that Dr. Work purposes to follow in justifying his political reorganization of the Reclamation Service.

To the Secretary of the Interior government reclamation comprises two distinct, and apparently mutually exclusive, parts—the "building of dams and ditches" and the "problem of the water users." The former he considers the whole duty of the engineer, but for the latter he would secure a "practical business man." No more condescending definition of the function of the engineer was ever written than this letter, and the workings of the author's mind in depreciation of the engineer and the magnification of the business man are more fully revealed in the memorandum.

This memorandum is a gem. Intended obviously to impress the casual reader with the radically different type of mind that is now in charge of government reclamation, it proceeds to recite as the novel items of a new policy precisely the same details in irrigation design and operation that have always governed the practice of irrigation engineering. It is not necessary to repeat those details to an engineering audience, but for others it may be well to say that irrigation engineering involves the proper selection of site, not only to insure the water supply but also to insure the proper agricultural and marketing conditions, the safe and economical construction of the physical elements of the project, the careful adjustment of the water service to the needs of the crops, the study of the agricultural processes for the education of the farmers, and finally the nice balance of human relations which is necessary to insure the well being of the settlers and their proper repayment of the funds to the government. These elements make up irrigation engineering. It is only when they become dignified with the magic words "business administration" that they warrant a special "memorandum for the press."

Government irrigation has not been an unqualified success. In that statement Dr. Work is correct. Irrigation on such an extensive scale as practiced in the West is a new art which requires learning with its development. Engineers today know much better how they should build and operate irrigation works than they did twenty years ago and in that degree they are to blame for the failure of complete success. Quite as much of the blame, however, lies in the law itself and in its administration by those superior to the engineer. Such disabilities would in nowise be removed by an assumption that the engineer is merely the builder of dams and the digger of ditches and that the larger policies of reclamation can be determined by some overhead business management which works quite independent of those who conceive and execute the physical elements of the irrigation scheme. Design, construction and operation are inextricably woven in irrigation as they are in all other engineering work. In the design and in the construction one type of engineering activity is required. In the operation and in the control another type is required, but the two are equally engineering functions.

All of this has been sufficiently obvious to the engineers who are interested in or have been connected with irrigation work. The opposite contention—the one held by Dr. Work—that the administration of irrigation requires a business man, has a certain appeal to that very large body of people who are hypnotized by this demand for a business administration of everything. It is only when the advocates of this plan attempt to put down in words a program for administration that they find difficulty in expressing the distinction between what they advocate and what has been practice. The "memorandum for the press" is the best illustration of this difficulty of specifying what is a business administration that could be offered in defense of the engineer.

The Mystery of Fatigue

FROM the time of the earliest researches into the failure of materials through the effect of a very large number of load repetitions, carried out by Wöhler and Bauschinger, the subject of fatigue has remained enveloped in its cloak of mystery. The elaborate investigations of recent years have supplied more exact and more complete facts on fatigue, but they have not done much toward dispelling the mystery. Not the slightest approach has been made toward an understanding of what goes on in the metal that causes it to break after 5,000,000 but not after 5,000 repetitions of a particular load; and all the new facts developed, such as that the repetition of loading strengthens rather than weakens the material, merely add to the difficulty.

From the standpoint of the further exploration of fact, the two series of investigations summarized in this issue—those of McAdam at Annapolis and those of Moore at Illinois—are of great importance and interest. To the civil engineer in particular the research work now begins to have tangible value, because for the first time it touches upon the subject of endurance range under other conditions than full reversal of stress. In both the Annapolis and the Illinois work of the past year there may be found certain definite conclusions concerning the general endurance range, and while differing in form they are not far from agreement, to the effect that the total stress range of endurance is independent of the absolute values of maximum and minimum stress, up to the point where the upper limit reaches the elastic limit (or some other critical stress) of the material.

A further fact of decided importance may be concluded from the Annapolis work, namely, that stress attack of quite different kinds is subject to substantially the same laws as to endurance. Tests under repeated torsion, repeated impact and reversed bending showed no essential difference, except in the numerical measure of the critical value for the particular kind of stress concerned. This fact, which rests on a large amount of remarkably consistent and harmonious experimental material, will keep the subject clear of much confusion that otherwise would involve it.

Nothing has been uncovered in the past two years' experimentation to weaken the force of the conclusion previously arrived at in the Illinois work that the endurance limit is identical with a critical stress value which may be determined in a few minutes by its relation to the rate at which heat is developed in a specimen subjected to repeated loading. Below the critical stress, heat is developed at one rate, while above this limit it is developed at a greater rate. That this "heating limit" is identical with the endurance limit which requires many months of testing to determine it may now be considered to be fully established for steel, since all the Illinois data, without exception, agree with it.

This established fact almost inevitably leads to the conclusion that the more rapid heat developed corresponds to some destructive action in the interior of the testpiece, bringing about a gradual weakening of the piece until its final rupture. It is, therefore, disconcerting to be told that no test, microscopic examination or other method of study has been able to reveal the slightest change in the material in the course of the repeated application of stress just above the endurance limit. The destructive action evidently must be of such nature as to escape any means of discovery we yet are able to apply. But is there a destructive action in progress at all? McAdam's work shows that if a stress at or just below the endurance limit is applied as many as ten million times, the testpiece is strengthened, not weakened: it is able to endure without failure many additional millions of stress repetitions at a much higher stress, far above the original endurance limit. The nature of this strengthening effect is as much of a mystery as the weakening which is made manifest by this fatigue failure, but it seems likely that the two effects are in some way closely related.

For the present the results of research seem to sum up in the fact that we have learned certain things about endurance, but are quite unable to correlate these things with other scientific knowledge, so that the subject remains a deep mystery. Doubtless this mystery conceals within itself a great many additional facts about endurance, and it may be that we are not yet within even fair reaching distance of knowing the essential phenomena of this important mechanical action. Research is bound to continue, therefore, at the full present rate—or, better still, at a greatly accelerated rate, to engage many more workers and thinkers than are now active in the subject.

How Oklahoma City Water-Works Dam Withstood Floods

Twice the Designed Capacity Passed Safely—High Water Record Broken Three Times in Month—Repairs Planned, Spillway to be Made Open and Bank Protection to be Extended

By A. S. Holway
Chief Engineer, Water Department, Oklahoma City, Okla.

JUNE FLOODS on the North Canadian River broke previous records on three successive rises at Oklahoma City. They washed out practically all bridges over it in Oklahoma and seriously threatened the water-works storage reservoir at Oklahoma City. An amount equivalent to nearly twice the capacity of the spillway facilities passed the dam and the water rose to within 6 in. of the top of an extremely long earthen embankment. Driftwood and floating bridge timbers caused much anxiety. The water conduit to the city paralleling the river below the dam was nearly washed out. Sandbags by the thousands saved the day, being used extensively at the ends of the concrete section of the dam, on top of the various earth embankments and in protecting the city conduit. While the information of the rainfall over the watershed is meager, observations taken by the Weather Bureau indicate only moderately heavy storms in June but heavy ones in May which saturated the area.

WATCHING A PILE BENT OF THE INTERURBAN "GO OUT"
Bridge floor planks removed (1) to get at drifting logs and haul them out by tractor and wire cable operating along upstream side of approach, (2) to salvage and prevent their floating downstream two miles and lodging against the dam spillways.

The North Canadian River is formed by the junction of Beaver Creek and Wolf Creek, which rise in northeastern New Mexico and northern Texas respectively. The 10,000-sq.mi. drainage area is situated principally on its upper tributaries through the panhandle of Oklahoma and Texas where it varies from 30 to 75 miles in width. For 100 miles above Oklahoma City the watershed is extremely narrow, in some places not more than a mile in width. Except for Beaver and Wolf creeks the tributaries are short, usually not more than 10 miles long. The watershed is composed in most part of a porous sandy soil, approximately 35 per cent under cultivation. The topography is more or less rolling in character. The river channel is very crooked and the rainfall is light, producing a sluggish flow.

The average annual rainfall in Oklahoma City is 31 in. per year, but the principal tributary drainage area lies in a region of smaller rainfalls, ranging from 25 in. near the eastern end of the Oklahoma panhandle to 15 in. at the extreme west end of the State and in northeastern New Mexico. The average rainfall, total area considered, is probably not far from 20 in.

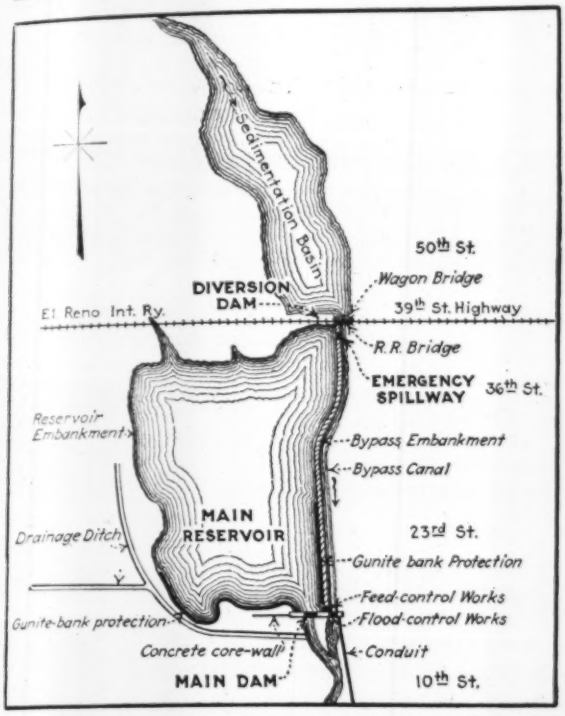
Excessive rains fell throughout the watershed May 21 to 23, with an average of 3.52 in. for thirteen stations. The heaviest rain, according to the U. S. Weather Bureau records, was 4.68 in. at Woodward. Newspaper reports indicate that there was more than 5 in. at many places at which there are no rain gages and from 8 to 10 in. at certain points.

Runoff from these storms was unusually heavy and rapid, raising the river gage at Oklahoma City to 13.9 ft. on May 22, the highest record since this gage was established. As the flood from the tributaries upstream passed down the river the gage at Oklahoma City showed 15.9 ft. on May 29, again the highest of record on this gage. The water from this flood covered the bottom lands and receded very slowly. Rain continued to fall over the watershed and on June 8 the river began rising rapidly at Woodward, reaching its crest at this station on June 10. The Weather Bureau records (see Table I) show general precipitation throughout the watershed, with 2.3 in. at Woodward and 3.25 in. at Canton, June 7 to 9. The records from other stations farther up the stream are incomplete for this period though the precipitation was doubtless heavy. The crest of the flood passed rapidly downstream reaching Canton at midnight on June 10, Reno Junction at 5 p.m. on June 12, the water supply reservoir at 10 p.m. on June 13 and Oklahoma City at noon June 14. At the latter place the gage reading was 16.3 ft., establishing a new record for the third time within thirty days.

The water supply reservoir was constructed in 1916-18 and the general layout is shown in the sketch. The structures consist of a hollow dam across the river valley approximately 1,100 ft. long, at the west end of which is an earthen dam with concrete core wall 1,200 ft. long.

Under ordinary conditions the river water flows through a shallow sedimentation reservoir, formed by an earthen diversion dam on which are the highway and interurban line. By this dam the water is diverted to the east side of the sedimentation reservoir, whence it flows through a bypass canal on the east side of the main reservoir to the flood control works which are located at the east end of the main dam. The 2-mile bypass canal is separated from the main reservoir by an earthen embankment originally built with an 18-ft. crown.

Flood control works at the lower end of the canal in the end of the dam consist of four electrically-operated sluice gates, 14 ft. high, and 9 ft. wide, having an estimated capacity of 8,000 cu.ft. per second. Four auxiliary spillways have an estimated capacity of 2,650 cu.ft. per second. These spillways are surmounted by a walkway across the dam. An emergency spillway of



OKLAHOMA WATER-WORKS STORAGE RESERVOIR AND SEDIMENTATION BASIN

7,850 sec.-ft. capacity at the north end of the bypass canal through the bypass embankment is so constructed that it will come into action at the time the flood control spillways start to overflow. Water flowing through this spillway passes through the reservoir to the spillway over the main dam. Feed control gates at the lower end of the bypass have a capacity of 1,220 cu.ft. per second, making a total capacity of all available gates and spillways of 19,720 cu.ft. per second.

In an engineer's report dated 1913 covering this project we read that the greatest recorded flow to that date was 3,640 sec.-ft. In the 1916 report covering the same project the engineer states: "We are undertaking to control the flood water of a stream capable of discharging in excess of 4,000 sec.-ft." This amount is equivalent to 0.4 sec.-ft. per square mile of drainage area. In October, 1920, after the dam was placed in operation a flood occurred carrying 8,750 sec.-ft. or 0.875 sec.-ft. per square mile. On May 28 of this year the flow was 10,000 sec.-ft. at the crest of the flood, or 1 sec-ft. per square mile. On June 13 the crest of the flood carried a total of 33,700 sec.-ft. or 3.37 sec.-ft. per square mile. The size of this flood takes on additional significance when we consider that during a period of three months of the summer of 1922 the flow of the river into the storage reservoir varied from 1 to 1½ sec.-ft.

In the afternoon of June 12 the water at the reservoir began rising very rapidly and by 9 o'clock the following morning the flood control gates and spillways were operating at their maximum capacity. Water began to run over the walkway across the entire length of the bypass dam. At the crest of the flood this walkway was finally overtopped by 1.8 ft.

Water began to run over the abutment on the east side of the dam and sand bags were called into use to prevent cutting away the earth to the east and below this abutment. The bags were carried up to a height of 3 ft. before the crest of the flood was reached. Soon after the walkway at the flood-control works was overtopped the water began to flow over low places in the embankment separating the bypass from the reservoir. Sand bags were again called into service and these low places were raised in such a way that the water flowing over this embankment was forced to flow 9 in. deep over the lower 5,000 ft. next to the dam, a section of the embankment recently improved by the construction of gunite revetment work, as described in *Engineering News-Record*, May 17, 1923, p. 880. The quantity of water carried over this embankment at the crest of the flood was estimated at 10,000 sec.-ft.

Throughout the day floating logs piled against the highway bridge at Thirty-ninth Street. This drift coupled with a severe scouring action at the bottom of the channel gradually weakened this structure until several 4-pile bents were undermined and finally went out, carrying with them the several 5-pile bents of the interurban bridge directly below. [Observations by a representative of *Engineering News-Record* in the afternoon and again about 8 p.m. disclosed that the first sign of weakness in the highway bridge was a slight curve, downstream, in the alignment. Shortly afterward the bridge started to sag at one of the undermined bents. Finally the bent passed out from below the bridge quite slowly and then floated against the interurban bridge. None of the structures went out with a rush. One of the interurban bents after floating from under the intact floor structure, turned end-for-end, the sharp ends of the piles giving a pinwheel effect in the rotation.—EDITOR.]

When it became evident that these bridges were going to fail the pipe handrails on the walkway across the bypass dam were cut to keep this drift from piling

TABLE I—DAILY PRECIPITATION FOR JUNE 1923 ON THE NORTH CANADIAN RIVER IN OKLAHOMA

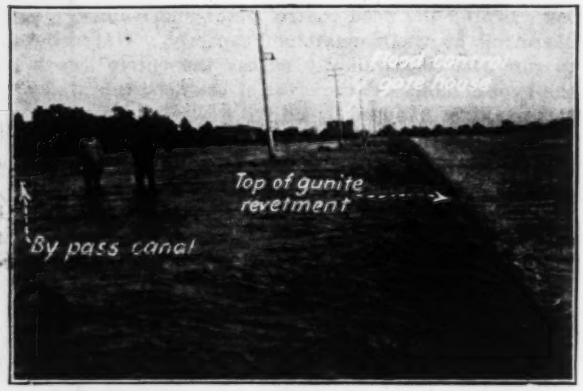
Stations—Watersheds	Days of Month														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Beaver	1.36	0	0	0.06	0.07	0.02	0.19	0.57	*	0.05	0	0	0.02	0	0
Woodward	1.52	0	0.10	0	0.04	0	0.02	0.88	1.40	0	0.01	0	0	0	0
Canton	1.00	0	0.09	0	0	0	0.61	0.52	2.12	0.10	0	0	0	0	0
Reno Junction	*	0	0	T	0.32	0	0.60	0.60	0.70	0.05	0	0	0	0	0
Oklahoma City	1.60	0	T	T	T	0	0.63	0	0.96	0	T	0	T	0	0

* No report—No doubt heavy.

TABLE II—CANADIAN RIVER READINGS DURING JUNE FLOODS IN OKLAHOMA

Date	Woodward	Canton	Reno Junction	Oklahoma City
June 1	3.0	0.9	...	12.1
June 2	6.0	3.3	3.9	11.3
June 3	3.6	5.0	3.9	11.1
June 4	3.6	1.0	5.2	10.6
June 5	4.3	1.0	6.8	11.3
June 6	3.1	2.0	5.9	11.8
June 7	3.0	0.6	4.6	13.0
June 8	5.0	0.2	4.6	12.4
June 9	4.0	5.3	4.4	12.1
June 10	8.3*	5.3†	4.9	11.9
June 11	4.0	...	7.4	11.3
June 12	3.8	3.2	10.5**	12.1
June 13	3.7	2.0	12.0	13.5
June 14	3.7	2.0	7.4	16.0***
June 15	2.8	1.0	5.6	15.1

* Highest stage 8.3 at 12 a.m.
† Highest stage 8.6 midnight June 10-11.
** Highest stage 14.0 at 5 p.m.
*** Highest stage 16.3 at noon.
Note—Readings taken at 7 a.m.



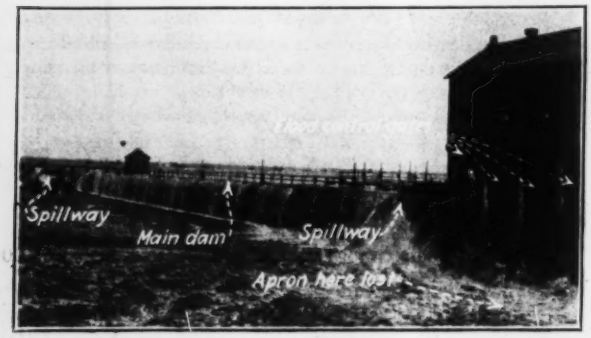
WATER OVERTOPPED THE CONCRETE WALKWAY OVER THE HOLLOW DAM

Spillway sections both sides of gatehouse and at far end of concrete section flooded out. Railing near gate house cut to prevent driftwood lodging against it. Concrete apron below flood-control gates was washed out entirely.

against the dam and flooding the spillways. A large proportion of the wreckage from these bridges was hauled to shore with tractors. That which got away was carried by the side current and lodged on the bypass embankment. Some of it passed over the top of the walkway and a small amount lodged against the spillways at the flood control gates. Two large logs were lodged in the flood-control gates and could not be removed until the flood receded.

The water passing over the top of the bypass embankment and through the emergency spillway gradually filled up the main reservoir until the spillway and wasteways were carrying their full capacity. The walkway the entire length of the main dam was finally overtopped 6 in. Sand bags were used to raise the walkway at the west end to prevent the water from dropping down close to the west end of the main dam, where it would have gradually washed away the earth and exposed the core wall, eventually emptying the reservoir around the west end of the concrete dam.

A large portion of the west side and south side of the main reservoir is lined by an earthen embankment to prevent the water from flooding the lowlands. A drainage ditch parallels this bank for several thousand feet. The top of this embankment is 1 ft. above the top of the walkway on the main dam. The highest point reached by the water in the main reservoir was therefore only 6 in. below the top of the embankment



OVERFLOW FROM THE MAIN RESERVOIR INTO THE BYPASS CANAL

The pole line indicates the inside edge of the embankment.

for a distance of approximately 20,000 ft. At some points this embankment is very narrow and a high wind the succeeding day threatened to destroy certain parts of it. Sand bags were again called into use.

One of the particular points of danger from the water supply standpoint was the fact that the conduit line to the city is laid close to the east bank of the river for ½ mile south of the dam. Part of the riprap bank protection 150 ft. below the dam was destroyed by the floods in May. Hundreds of sand bags were used at this point to protect the shore from further erosion and to prevent the destruction of the water-supply conduit line.

In view of the fact that the flood was practically twice as great as the total capacity of all gates and spillways it is remarkable that so little actual damage occurred.

It will be necessary to replace the highway and interurban bridges at Thirty-ninth Street and the riprap bank protection below the spillway on the east side of the river. The concrete apron below the flood control gates was entirely destroyed. Some little wash occurred in spots over the bypass embankment but the gunite protection work remained intact. Plans were immediately started for making these repairs and certain changes to care for future floods which may equal or exceed this flood in severity. In some way the walkway across the flood-control dam must be eliminated to give a free spillway opening that cannot become clogged with drift. The capacity of the emergency spillway and of the spillway discharging from the main reservoir both need increasing. It is further planned to extend the bank protection work to all the earth sections which were so nearly overtopped. A row of piles will be driven across the sedimentation reservoir north of the highway bridge, at a point where the velocity will be extremely low, to catch whatever drift comes down the river. With the low velocity trees and floating debris can be easily removed to shore.

The Engineer in the Cabinet

"What Washington occasionally calls the important big three of the Cabinet are Hughes, Hoover and Mellon. Hughes and Mellon are in this group apart because of the importance of their particular offices, as well as because of their ability. Hoover is in it in spite of the relatively less importance of his Commerce Department, because of his extraordinary personal ability and because, as a matter of fact, he is so well grounded and so indispensable in many big matters that come up outside the limits of his particular official field. As to Secretary Hoover, in addition to his own department, he is everything that is embraced in the dignity and efficiency of the phrase, "a competent workman." He contributes able and faithful trustworthiness for such frequently arising emergencies as coal strikes, unemployment, conservation and a dozen other matters calling for hard work, concentration of mind and immensely varied knowledge. It was one of the comparatively few easing comforts that Mr. Harding had in his difficult Presidency to know that at any hour, day or night, Mr. Hoover was at the end of the telephone wire, subject to call for any emergency. It was a reliance of which Mr. Harding made frequent use."—Mark Sullivan, in the *New York Tribune*, Aug. 6, 1923.

Sledged-Stone Base Developed For Missouri Roads

One-Man Stone Sledged Down, Filled With Spalls and Rolled Gives Cheap and Durable Base From Soft Native Rocks

SLEDGED-STONE base, with penetration macadam or asphaltic-concrete surface, has been adopted as a standard construction on Missouri highways. On the porous, easily-drained soils of large sections of the state these bases are standing up excellently and are being placed at an appreciable saving as compared with crushed stone or hand-placed Telford. Quarry rocks too soft to provide a crushed stone that will wear can be used as one-man stone for sledged base. Limestone has been used commonly but now sandstone is being tried where it is the native rock.

Rock is plentiful in most parts of Missouri, but there is little which has the coefficient of hardness required of crushed stone suitable for modern macadam. In large sizes—one-man stone—the softness is less objectionable than when the rock is crushed. Used as a base and filled with spalls, crushed stone and screenings, the large stone apparently break down very slowly due to internal movement of the fragments, but crushed bases of this rock grind up quickly. Hence the sledged-stone base has developed as a means of utilizing local rocks. Briefly it consists of large stone bound together and interlocked by sledging after which spalls, crushed stone and screenings are filled into the interstices and rolled firm and smooth.

FIG. 3—SLEDGED-STONE BASE READY FOR SURFACING

The sizes of stone used run about as follows: (1) As large as one man can readily handle, (2) spalls of any size up to 6 in., (3) crushed stone passing a 3-in. ring and (4) screenings which comprise all fragments passing a ¾-in. ring. The large stone are uniformly spread on a prepared subgrade as of the section shown by Fig. 1. Then men with 10 or 12-lb. sledges, as indicated by Fig. 2, pound down the projecting tops and hammer the stone into contact and interlock. In sledging, the men work to secure as nearly uniform depth and as even a surface as possible. The surface is then rolled with a 10-ton roller to set and interlock the stone still further than did the sledging. Spalls and crushed stone are next spread to level the surface and then the base is rerolled. The screenings are used to fill in remaining hollows and the base is again rolled. Fig. 3 shows the appearance of a finished sledged-stone base. On this any type of surfacing can be laid.

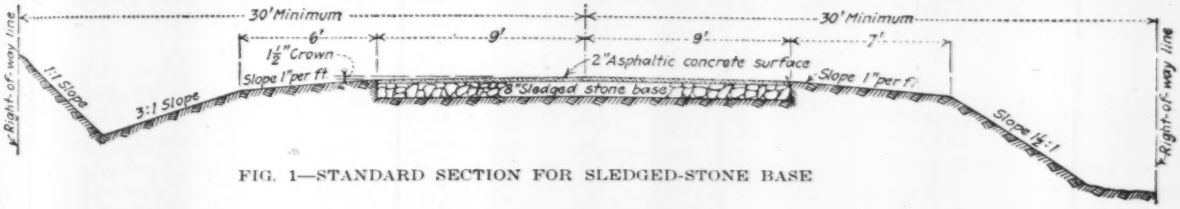


FIG. 1—STANDARD SECTION FOR SLEDGED-STONE BASE

FIG. 2—SLEDGING THE LARGE STONES INTO PLACE

In contracting for sledged-stone base the practice is to pay a unit price per cubic yard for ½-mile haul and an additional price for each additional ½-mile haul. Measurement is made at the point of delivery and the price includes loading, unloading, sledging, rolling, etc. —complete base ready for surfacing.

Finish Alaska Topographic and Mining Survey

In the recent extensive work in Alaska by the Geological Survey of the Department of the Interior, 250,000 square miles, or about 34 per cent of the entire Territory, have been topographically surveyed and 200,000 square miles, or 30 per cent, have been geologically surveyed. In addition, detailed geological surveys have been made of sixteen of the largest mining districts totaling 5,000 square miles, including all of the important coal fields and several of the important copper and gold mining districts. Investigations of the water resources have also been made.

Improved Gantry Cranes for the Port of Hamburg, Germany

Unusual Combination of Swinging and Traveling Cranes Increases the Cargo Handling Facilities of the Port

BY E. KRAHNEN
Duisburg, Germany

DOUBLE cranes of novel design have recently been installed at the port of Hamburg, Germany. They are a combination of a traveling revolving crane on a high superstructure and a straight line crane or transporter. To meet local conditions four combinations have been evolved.

Originally the crab of the straight line crane accompanied the load and carried the winding gear as well as the cabin with the man manipulating the winch (Fig. 1). In later designs a fixed winch located on the gantry is preferred, the operator having his stand on one of the gantry legs from where he can overlook the hold as well as the movements of the load on its way into the shed (Fig. 2). The runway of this type of cranes can be less substantial, a valuable feature if the reach has to be considerable. In a third design the jib of the revolving crane forms a runway for a second crab. It can be lowered so far that the load may be transported horizontally, thus forming a second straight line crane that can be turned in a convenient angle to the pier (Fig. 3). In some cases a combination of two revolving cranes and one straight line crane is desired. The revolving cranes are placed on each side of the runway girder in such a way that three cranes can work over one hatch. The runway girder is designed so that it can be drawn in behind the edge of the pier. If the reach is large the runway can also be built as a cantilever, capable of being lowered and raised out of the way on a hinge (Fig. 4). These four types of crane show the adaptability of double cranes.

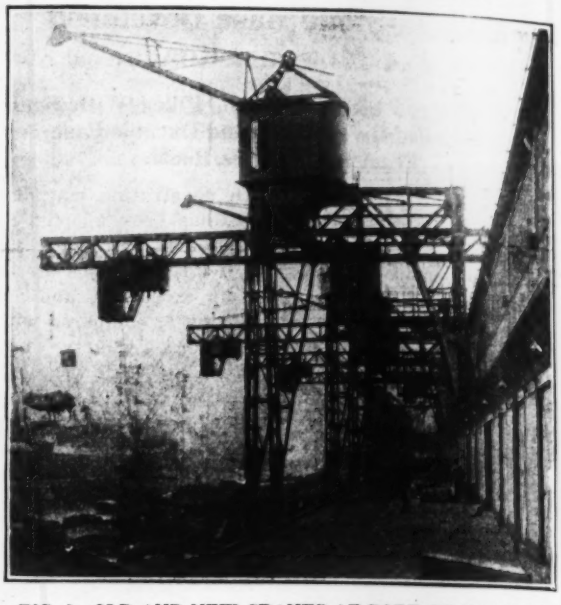


FIG. 5—OLD AND NEW CRANES AT PORT OF HAMBURG
New double cranes are the first four in the foreground; behind them are the radius cranes of 1900 type.

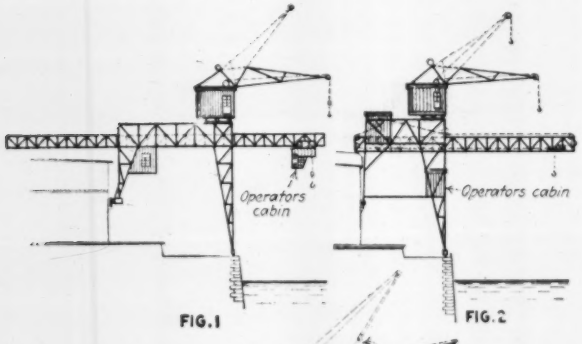


FIG. 1 FIG. 2

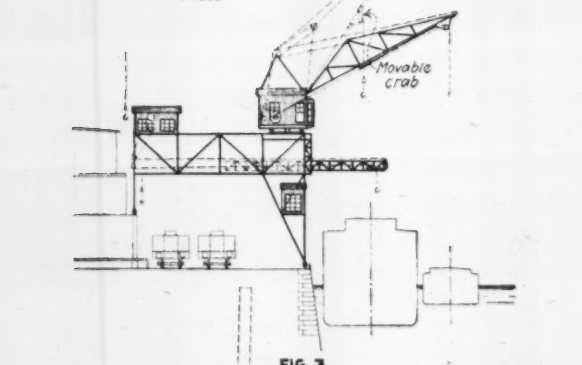


FIG. 3

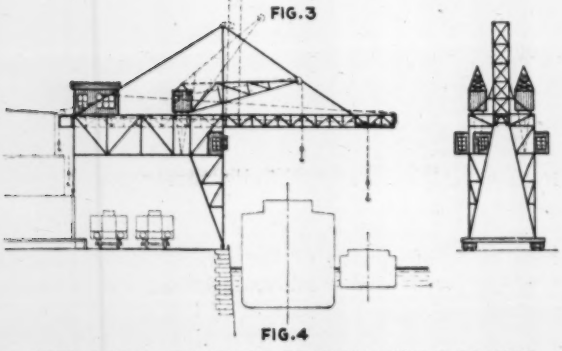


FIG. 4

FIGS. 1 TO 4—DIAGRAMS OF THE DOUBLE CRANES

The straight line crane is employed for general cargo that easily passes between the legs of the gantry. It reaches well into the pier and can operate without danger of conflict with the ship's rigging. The load is moved in the shortest way possible and only needs to be lifted to the height required without having to be lifted over deck superstructures as is necessary with revolving cranes while swinging the load. The runway can be designed to reach over two ships allowing direct transfers from the ship to a lighter beyond. Such movements constitute a large part of the traffic of many ports. A revolving crane is not well adapted to this kind of transfer as the ship's masts and yards constitute a serious obstruction to radial movements of any considerable extent. The crab of the straight line crane is usually built for a capacity of 1½ tons, which is sufficient for general cargo. It works with the high speed of 400 ft. per minute and as no superfluous work has to be done upon the load 40 cycles per minute can be easily attained. Under the same conditions a revolving crane could accomplish only 25 cycles and would require more current for the same amount of work. The winch is of a very simple design and well adapted to the rapidity with which the load is moved. The hoisting and crab traveling ropes are taken up by two drums which can be worked separately or simultaneously.

The revolving crane is usually built for a capacity

of 3 tons, a larger load than ships' gear can handle. Loads of nearly double the capacity of the single draft can be handled by two cranes working together.

In order to work a hatch at full capacity two cranes can be so placed together that four hooks are available for one hatch, the two straight line cranes working in the center while the revolving cranes are handling freight at the corners of the hold. By spotting the booms no time is lost in finding the opening of the hold with each successive draft. The revolving cranes can also be working the corners of the hatch while the straight line cranes are handling deck loads.

The longitudinal travel of the whole crane is effected by means of a hand traveling gear where the cranes are placed close together. For cranes that have to travel a considerable distance along the quai an electrically operated gear is provided.

The cranes at Hamburg were furnished by the Demag Company, Duisburg, Germany.

State Aid for Bridges on State Highways

A STUDY of systems of payment for bridges on state highways, made by the legislative reference library in New York State, shows that twenty-seven out of the forty-eight states of the Union have laws under which the state pays or may pay the entire cost of construction of such bridges, while in sixteen the state bears part of the cost. Five pay no part of the cost of state highway bridges. The sixteen which pay part of the cost includes three in which the state share of payment is limited to "state-aid" road bridges. In addition, five of the states which pay or may pay all the cost on bridges and state highways also have provision for the state paying part of the cost on "state-aid" roads. The lists follow:

STATE PAYS TOTAL COST OF BRIDGES ON STATE HIGHWAYS

Alabama	
Arizona	
California	The law is not clear but it would appear that state bears total cost.
Colorado	The law is not clear but it would appear that state bears total cost.
Delaware	
Florida	
Georgia	
Idaho	State may construct at its own cost.
Illinois	
Indiana	
Iowa	The law is not clear but it would appear that state bears total cost.
Kentucky	State is to bear total cost, but counties and municipalities may contribute if they wish.
Maine	
Maryland	
Michigan	State constructs and pays cost of all bridges greater than 30-ft. span.
Minnesota	
Missouri	
Montana	The law is not clear but it would appear that state bears total cost.
New Hampshire	
New Jersey	
North Carolina	
Pennsylvania	
Rhode Island	
South Dakota	
Washington	
West Virginia	
Wyoming	

STATE PAYS PART OF COST OF BRIDGES ON STATE HIGHWAYS

Arkansas	Not to exceed fifty per cent of cost.
Connecticut	From one-third to seven-eighths of cost.
Louisiana	Fifty per cent of cost.
Massachusetts	Three-fourths of cost.
Mississippi	State may pay part of the cost.
New Mexico	Not to exceed fifty per cent of cost.
North Dakota	Fifty per cent of the cost.
Ohio	Cost to be apportioned equally between state and county or township unless the county and township have agreed to pay more.
Tennessee	Contributes a certain share of cost and may require any county to contribute not to exceed fifty per cent of cost.
Utah	Contributes from one-fourth, one-half to full amount of same sum raised by counties.
Vermont	Not to exceed one-third of cost; town pays the balance.
Virginia	Fifty per cent of the cost.
Wisconsin	Fifty per cent of the cost.

(In addition to the above list, *Alabama* has a provision that the state may pay part of the cost instead of all, while in *Idaho* the state may pay one-third and the county two-thirds, instead of the state paying all.)

STATE PAYS PART OF COST OF BRIDGES ON "STATE-AID" ROADS

Kansas	Not to exceed twenty-five per cent of cost.
Nevada	State and county jointly bear cost of construction.
Texas	Twenty-five to fifty per cent of cost; in unorganized counties state may bear all of cost.

(In addition *Delaware*, *Florida*, *Maine*, *Michigan* and *Minnesota*, all included in the first table above, pay or may pay part of the cost of bridges on "state-aid" roads.)

STATE PAYS NO PART OF COST OF BRIDGES ON STATE HIGHWAYS

Nebraska	County maintains whole of state highway system within its borders.
New York	State constructs only culverts 5 ft. or less in length as a part of highway system. New York State, however, while its highway law specifically provides that no bridges over 5 ft. shall be built or maintained as a part of the highway system, has on a number of occasions provided by special appropriation for the construction of certain bridges and has made them a part of the highway system of the state, most recently the Poughkeepsie bridge across the Hudson River.
Oklahoma	County bears entire cost of construction.
Oregon	State loans funds to counties which counties repay in full.
South Carolina	

Scientist Heads New Italian Department

The four Italian government Departments of Industry, Commerce, Agriculture and Labor have been combined in a Department of National Economy, with four bureaus corresponding to the old departments, each headed by a director. Prof. Orso Mario Corbino has been made minister of National Economy and Prof. Arrigo Serpieri has been made undersecretary. Secretary Corbino was nominated professor of physics at the University of Rome in 1918. He became senator in 1920 and minister of Public Instruction in 1921. He has devoted himself largely to water-power development. Prof. Serpieri has specialized in agriculture. Each is an author of technical papers and books.

Endurance of Steel in Tension, Torsion and Impact

Results Show Endurance Under Three Kinds of Stressing Is of Same General Kind, Though Numerical Values Differ

Abstract of a paper by D. J. McAdam, Naval Engineering Experiment Station, Annapolis, presented at the Annual Meeting of the American Society for Testing Materials.

DATA and conclusions which add to prior knowledge of the endurance or fatigue-resisting power of steels were given by D. J. McAdam, of the Naval Engineering Experiment Station at Annapolis. His tests included not only the conventional rotating-beam tests for endurance in reversed bending, but also endurance tests in reversed torsion and tests under repeated impact of a hammer falling with definite amount of energy per blow. The results obtained are remarkably consistent, forming smooth curves and leading to mutually confirmatory deductions. It is shown that (1) the endurance under the three kinds of stressing is of the same general kind, though the numerical values differ; and (2) repeated stressing at a stress which does not produce fracture tends to strengthen the piece, giving it a higher endurance than possessed by a similar piece without such preliminary stressing. The effect of the heat treatment of the material and of its internal structure are also illuminated by the test results.

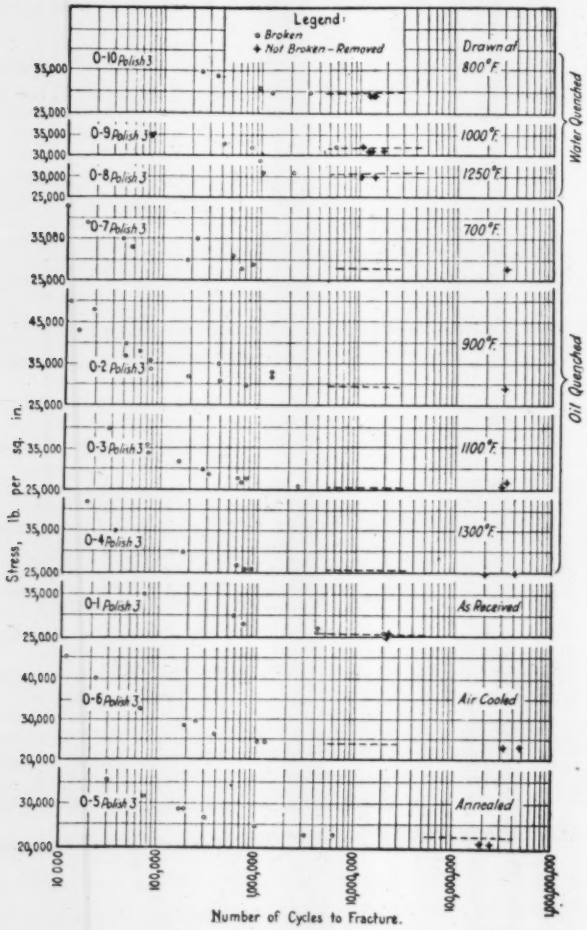


FIG. 1—REVERSED-BENDING ENDURANCE CURVES
For steel of 0.24 carbon and 0.45 manganese. Horizontal dash lines represent the point where the curve of the results intersects the 10,000,000-cycle vertical, which is taken as the endurance limit.

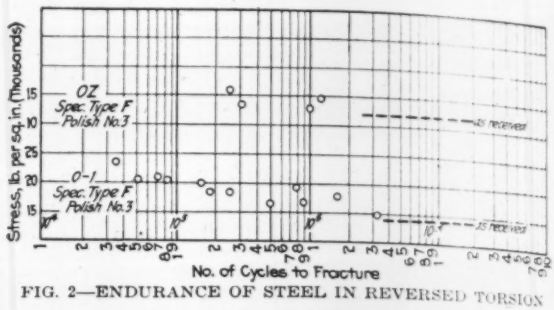


FIG. 2—ENDURANCE OF STEEL IN REVERSED TORSION

Rotating-beam tests were made on cantilever specimens at speeds of 1,200 to 800 r.p.m. Reversed-torsion tests were made in machines of two different forms, and in most of the sets were run at a speed of 2,140 r.p.m., although check tests covering a large range of speeds and of flywheel inertia showed these factors to be without material influence on the endurance limit. In the impact endurance tests a beam specimen supported at both ends was rotated intermittently, coming to rest after each 90-deg. rotation, and during this rest was struck by a hammer previously lifted by a cam. The frequency ranged from 90 to 600 blows per minute. The weight of hammer and height of fall were adjusted to the desired energy per blow, and this was so controlled as to require from 500 to many million blows for fracture. By a special arrangement still greater energy per blow was provided for, and tests were carried down to the point where a single blow fractured the specimen. Very uniform results were obtained, plotting in smooth curves. In this test, as in the torsion and tension tests, the curves approached a horizontal line in the neighborhood of 10,000,000 repetitions, and in all cases the value at 10,000,000 cycles was taken as the endurance limit.

Material—A large number of different steels was experimented with, ranging from ingot iron with 0.023 per cent carbon to high-carbon steel, nickel steel, nickel-chrome, and other alloy steels. Each was tested with various heat treatments: as received, annealed, water-quenched and drawn at different temperatures, oil-quenched and drawn at different temperatures. The critical part of the specimen in each case was polished after turning to size, and different kinds of polish were tried out, without showing any significant differences whatever.

The differences in composition of the steels and their differences of treatment produced a total range of 47,000 to 201,000 in tensile strength, 30,000 to 165,000 in yield point, and 40,000 to 124,000 in ultimate torsional strength.

Reversed-Bending Endurance — Plotted on paper with logarithmic abscissas and arithmetic ordinates the results of the reversed-bending tests yielded fairly regular curves; Fig. 1 is a typical set of diagrams, in which, however, the curves have not been drawn. All the plots became practically horizontal beyond 10,000,000 cycles, so that only the horizontal portion was drawn. The series of diagrams in Fig. 1 indicates that the endurance limit is raised by quenching, and is raised more by water quenching than by oil quenching; that it is decreased by drawing about in proportion to the temperature; and that it is lowest for the annealed material. In this respect all the endurance tests gave the same indication.

In a number of experiments a specimen was first subjected to 10,000,000 or more cycles at a stress below its expected endurance limit, then another 10,000,000 cycles at a stress slightly higher, and so on in 1,000 or 2,000-lb. steps until the specimen broke. Each time the stress was raised, counting of cycles started at zero for the purpose of entering the result in the diagram. It was found that a marked increase in endurance resulted from the low-stress repetitions.

Tests made on material from crank shafts of battleships, submarines and airplanes showed lower endurance limits

TABLE—ENDURANCE LIMITS FOR BAR MATERIAL

Material Designation	Cooled in	Drawn at—Deg. Fahr.	Average Tensile Strength, Lb. per Sq.In.	Average Torsional Strength, Lb. per Sq.In.	Endurance Limit For 10,000,000 Cycles, Lb. per Sq.In. Rotating Cantilever	Alternating Torsion	Ratio of Values: Col. 5 to Column 4	Col. 7 to Column 6	Column 6 to Column 4	Column 7 to Column 4	Column 7 to Column 5
1	2	3	4	5	6	7	8	9	10	11	12
N-8	Water	.....	46,700	40,700	25,000	.....	0.872	.....	0.535	.....	.....
O-10	Water	800	78,820	60,200	29,500	.....	0.764	.....	0.374	.....	.....
O-9	Water	1,000	79,160	59,300	31,500	.....	0.749	.....	0.398	.....	.....
O-8	Water	1,250	67,100	54,300	30,500	.....	0.809	.....	0.455	.....	.....
O-7	Oil	700	68,500	56,600	27,500	.....	0.826	.....	0.401	.....	.....
O-2	Oil	900	67,500	60,500	29,500	.....	0.896	.....	0.437	.....	.....
O-3	Oil	1,100	66,000	53,440	25,500	.....	0.810	.....	0.386	.....	.....
O-4	Oil	1,300	60,300	52,300	25,500	.....	0.867	.....	0.423	.....	.....
O-1	As Received		60,400	53,430	25,500	14,000	0.885	0.549	0.422	0.232	0.262
O-6	Air	.....	60,750	48,730	24,500	.....	0.802	.....	0.403	.....	.....
O-5	Furnace	.....	55,120	46,640	22,500	.....	0.846	.....	8.408	.....	.....
Average of O Material						.....	0.775	0.549	0.411	0.232	0.262
T-8$_2$	Water	800	96,620	67,480	38,500	.....	0.698	.....	0.398	.....	.....
T-8	Water	800	85,250	63,390	34,500	.....	0.744	.....	0.405	.....	.....
T-10	Water	1,000	97,370	60,450	41,500	.....	0.621	.....	0.426	.....	.....
T-11	Water	1,100	86,250	64,300	39,500	.....	0.746	.....	0.458	.....	.....
T-9	Water	1,250	82,000	62,490	35,500	.....	0.767	.....	0.433	.....	.....
T-6	Oil	800	91,500	57,730	33,500	20,500	0.631	0.612	0.366	0.224	0.355
T-5	Oil	1,000	85,250	65,210	33,500	16,500	0.765	0.493	0.393	0.194	0.253
T-4	Oil	1,250	84,010	56,150	33,500	21,500	0.668	0.642	0.423	0.256	0.383
T-2	Air	.....	77,490	67,020	32,000	17,500	0.865	0.547	0.413	0.226	0.261
T-1	Furnace	.....	70,000	60,000	30,500	18,000	0.857	0.590	0.436	0.257	0.300
T-1$_2$	Furnace	.....	69,370	54,300	28,500	.....	0.783	.....	0.411	.....	.....
T-3	Furnace	.....	72,000	54,790	29,500	16,000	0.761	0.545	0.410	0.222	0.292
T-7	Furnace	.....	70,000	52,980	29,500	.....	0.757	.....	0.421	.....	.....
Average of T Material						.....	0.743	0.571	0.415	0.230	0.307
S-2$_2$	Air	.....	119,300	74,270	40,500	.....	0.623	.....	0.339	.....	.....
S-2	Air	.....	110,000	72,000	38,500	.....	0.655	.....	0.350	.....	.....
S-1	Furnace	.....	89,750	70,645	31,500	19,000	0.787	0.603	0.351	0.212	0.269
R-1$_2$	Furnace	.....	91,890	.....	34,500	.....	.....	.....	0.375	.....	.....
R-1	Furnace	.....	87,500	69,900	32,500	.....	0.799	.....	0.371	.....	.....
Average of S and R Material						.....	0.732	0.603	0.355	0.212	0.269
P-8	Water	900	154,200	91,370	74,000	47,000	0.593	0.635	0.480	0.305	0.514
P-7	Water	1,000	149,250	93,300	74,500	.....	0.625	.....	0.499	.....	.....
P-6	Water	1,100	132,250	86,940	72,000	46,500	0.657	0.648	0.544	0.351	0.534
P-5$_2$	Oil	900	118,000	77,000	66,500	38,000	0.653	0.571	0.564	0.322	0.494
P-3	Oil	1,150	123,000	81,060	59,500	.....	0.659	.....	0.484	.....	.....
P-2$_2$	Furnace	.....	113,630	77,890	51,000	22,500	0.685	0.441	0.449	0.198	0.298
Average of P Material						.....	0.645	0.574	0.503	0.294	0.460
Q-17	Water	900	145,750	99,000	.....	44,000	0.679	.....	.....	0.302	0.444
Q-15$_2$	Water	900	145,880	.....	69,500	.....	.....	.....	0.476	.....	.....
Q-17$_2$	Water	900	138,750	88,000	.....	42,000	0.634	.....	.....	0.303	0.477
Q-15	Water	900	142,900	88,750	64,500	.....	0.621	.....	0.451	.....	.....
Q-14	Water	1,100	115,900	77,890	59,000	.....	0.672	.....	0.509	.....	.....
Q-16$_3$	Water	1,200	112,000	.....	63,000	.....	.....	.....	0.563	.....	.....
Q-16	Water	1,200	99,100	69,700	55,000	.....	0.703	.....	0.555	.....	.....
Q-16$_2$	Water	1,200	107,500	.....	57,000	.....	.....	.....	0.530	.....	.....
Q-12	Oil	900	117,500	77,000	54,500	35,000	0.655	0.642	0.464	0.298	0.455
Q-8	Oil	950	154,000	96,000	63,500	45,000	0.623	0.709	0.412	0.292	0.469
Q-7	Oil	1,050	155,500	111,400	59,500	48,000	0.703	0.807	0.375	0.303	0.421
Q-13	Oil	1,100	97,600	71,400	48,000	.....	0.732	.....	0.492	.....	.....
Q-6	Oil	1,150	115,500	77,890	54,000	37,500	0.674	0.694	0.468	0.325	0.481
Q-3	Oil	1,200	97,500	67,920	47,500	.....	0.697	.....	0.487	.....	.....
Q-10	Air	.....	91,050	67,300	42,500	.....	0.739	.....	0.467	.....	.....
Q-11	Furnace	.....	85,500	60,000	41,500	.....	0.702	.....	0.485	.....	.....
Q-5$_3$	Furnace	.....	90,800	.....	50,000	.....	.....	.....	0.551	.....	.....
Q-5$_2$	Furnace	.....	80,600	61,500	42,000	.....	0.763	.....	0.521	.....	.....
Q-5$_1$	Furnace	.....	86,450	62,000	43,000	.....	0.717	.....	0.497	.....	.....
Q-5	Furnace	.....	103,900	.....	49,500	28,000	.....	0.566	0.476	0.269	.....
Average of Q Material						.....	0.688	0.684	0.488	0.285	0.458
Xa-2	Water	900	121,570	.....	68,000	.....	.....	.....	0.559	.....	.....
Xa-3	Water	1,100	136,630	73,050	68,500	.....	0.535	.....	0.501	.....	.....
Xa-1	Furnace	.....	85,750	.....	38,500	.....	.....	.....	0.449	.....	.....
Average of Xa Material						.....	0.535	.....	0.503	.....	.....
Xb-2	Water	900	164,750	104,150	72,500	.....	0.632	.....	0.440	.....	.....
Xb-3	Water	1,100	139,880	86,040	63,500	.....	0.615	.....	0.454	.....	.....
Xb-1	Furnace	.....	82,430	62,950	36,500	.....	0.764	.....	0.443	.....	.....
Average of Xb Material						.....	0.670	.....	0.446	.....	.....
Xc-2	Water	900	172,000	125,510	88,000	.....	0.730	.....	0.511	.....	.....
Xc-3	Water	1,100	157,000	103,370	77,000	.....	0.658	.....	0.490	.....	.....
Xc-1	Furnace	.....	111,350	76,700	49,500	.....	0.689	.....	0.445	.....	.....
Average of Xc Material						.....	0.692	.....	0.482	.....	.....
Y-2	Water	900	201,000	124,080	94,500	.....	0.617	.....	0.470	.....	.....
Y-2$_2$	Water	900	147,740	.....	78,500	.....	.....	.....	0.531	.....	.....
Y-3	Water	1,100	164,400	110,490	92,000	.....	0.672	.....	0.560	.....	.....
Y-1	Furnace	.....	101,750	76,980	44,500	.....	0.757	.....	0.437	.....	.....
Average of Y Material						.....	0.682	.....	0.500	.....	.....
Z-2	Water	900	164,500	95,290	84,500	.....	0.579	.....	0.514	.....	.....
Z-3	Water	1,100	144,250	82,420	72,000	.....	0.571	.....	0.499	.....	.....
Z-1	Furnace	.....	117,750	78,500	50,000	.....	0.667	.....	0.425	.....	.....
Average of Z Material						.....	0.606	.....	0.479	...	.....

for specimens taken in the transverse direction or from the block cut out between the crank webs, where the material had not been forged as thoroughly as elsewhere.

Reversed-Torsion Endurance—In torsion the results were closely parallel to those in tension, both as to the effect of heat treatment and as to the merging of the failure curve into a horizontal line at about 10,000,000 cycles. The effects of "fiber" as indicated by the results on transverse specimens from shafts also corresponded to those obtained in bending.

Impact Endurance—For the principal impact endurance tests, a specimen of ½-in. diameter was used, with a parallel-sided notch at mid-length of 0.4-in. bottom diameter and bottom radius $\frac{1}{16}$ in. Other tests, made with a V-notch

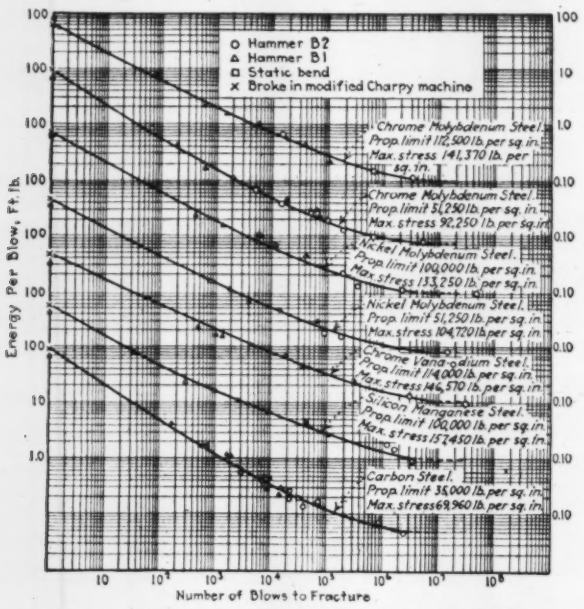

o Hammer B2
Δ Hammer B1
□ Static bend
× Broke in modified Charpy machine
Chrome Molybdenum Steel.
Prop. limit 112,500 lb. per sq. in.
Max. stress 141,370 lb. per sq. in.
Chrome Molybdenum Steel.
Prop. limit 51,250 lb. per sq. in.
Max. stress 92,250 lb. per sq. in.
Nickel Molybdenum Steel.
Prop. limit 100,000 lb. per sq. in.
Max. stress 133,250 lb. per sq. in.
Nickel Molybdenum Steel.
Prop. limit 51,250 lb. per sq. in.
Max. stress 104,720 lb. per sq. in.
Chrome Vanadium Steel.
Prop. limit 114,000 lb. per sq. in.
Max. stress 146,570 lb. per sq. in.
Silicon Manganese Steel.
Prop. limit 100,000 lb. per sq. in.
Max. stress 157,450 lb. per sq. in.
Carbon Steel.
Prop. limit 35,000 lb. per sq. in.
Max. stress 69,960 lb. per sq. in.
Energy Per Blow, Ft. lb.
Number of Blows to Fracture

FIG. 3—REPEATED-IMPACT ENDURANCE CURVES

The left-hand ordinate of each curve is the energy required to break the specimen in one blow. The tests with smaller amounts of energy per blow extend to values requiring more than 20,000,000 blows for fracture and include one test with more than 40,000,000 blows in which fracture did not result.

specimen of much sharper curvature at the bottom of the notch, confirmed the results.

A typical series of curves is shown in Fig. 3. The curves are remarkably smooth. The ordinates at the left ends of the curves, representing single-blow impact fracture, are roughly proportional to the Charpy impact values, though differing from the latter because of the difference in form of specimen. The endurance limits (ordinates of the horizontal portion at the right) have no relation to the Charpy values, however, but are proportional to the reversed-bending endurance limit. For the seven materials represented in Fig. 3 the ratio of the reversed-bending endurance (lb. per sq.in.) to the impact endurance (energy per blow) ranges from 550,000 to 670,000, and four of the ratios lie between 610,000 and 630,000. The Charpy values for these materials, on the other hand, range from 3.7 to 29.1. Thus, impact endurance does not depend on the Charpy value but depends directly on the reversed-bending endurance limit.

If an attempt is made to measure impact endurance by a relatively small number of blows, so that the value found would lie in the sloping part of the curve in Fig. 3, the result would be influenced jointly by the Charpy value (which controls the position of the curve at the extreme left) and the bending endurance (which controls the limit at the right), and therefore would not measure any single property of the material nor indicate the true impact endurance.

Endurance Ratios—A tabulation of endurance limits and their ratios to each other and to static strength properties is given in the table. The endurance ratio, or the ratio of reversed-bending endurance limit to tensile strength, is given in column 10. For the different steels the average ratio varies from 0.355 to 0.503. The chemical composition appears to affect the endurance ratio. For high-carbon steel the average ratio is about 0.35, while for low and medium-carbon steels it is about 0.41 and for 3½ per cent nickel steel it is about 0.50.

Fuller study of the endurance ratio is represented by the diagrams Fig. 4, where endurance limit is plotted as ordinate and tensile strength as abscissa, separately for different kinds of steel. The straight lines are drawn so as to pass through the origin of co-ordinates, and their tangents represent the endurance ratios. In the lower diagram the lines from left to right represent respectively ingot iron, mild steel, and high-carbon steel; the endurance ratio is least for the latter. In (b) of Fig. 4 the two lines represent nickel steels and medium-carbon steels, the former having the higher ratio. Diagram (c) represents annealed carbon and alloy steels. Ingot iron is at the left of the mean line drawn, high-carbon steels are at the right or below, and nickel steels form a group of seven points well above the line. The diagram is taken to indicate that in the annealed condition the endurance ratio of 3½ per cent nickel steel is higher than that of chrome-molybdenum, chrome-vanadium, low nickel-chrome steel, and all carbon steels except ingot iron. The endurance ratio for annealed high nickel-chrome steel has not yet been determined.

Fig. 5 gives the torsional endurance ratio, referred to tensile strength and torsional strength respectively. In both cases the plotted points fairly well fit straight lines passing through the origin, just as in the case of the reversed-bending ratio. Fig. 5 also indicates that the endurance ratio of nickel steels is higher than that of carbon steels (0.28 as compared with 0.22). The crank-shaft diagram in Fig. 5 represents a ratio of 0.22, as for carbon steel bar material.

It appears that the endurance ratio decreases as the percentage of pearlite in the steel increases. Even the endurance limit itself is lowered by the first addition of cementite to ferrite; with greater increase of carbon and therefore of cementite the endurance limit is increased, but the ratio drops. Addition of nickel apparently strengthens the ferrite, with the result that the endurance ratio is raised.

Studies of the ratios of endurance limits to proportional limits do not show as regular relationship as the ratios to ultimate strength. The plotted lines generally start from the origin with a slope of about 45 deg., and then gradually curve to the right, concave downward. Thus for low

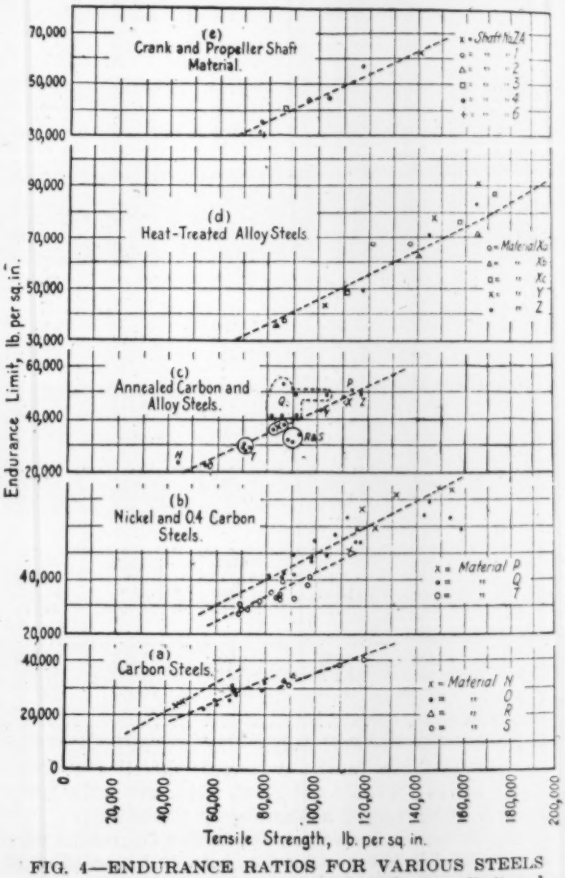


FIG. 4—ENDURANCE RATIOS FOR VARIOUS STEELS

Relation between tension-compression endurance limit and tensile strength. The plotted points show a fair straight-line relationship. Lines drawn to pass through the origin.

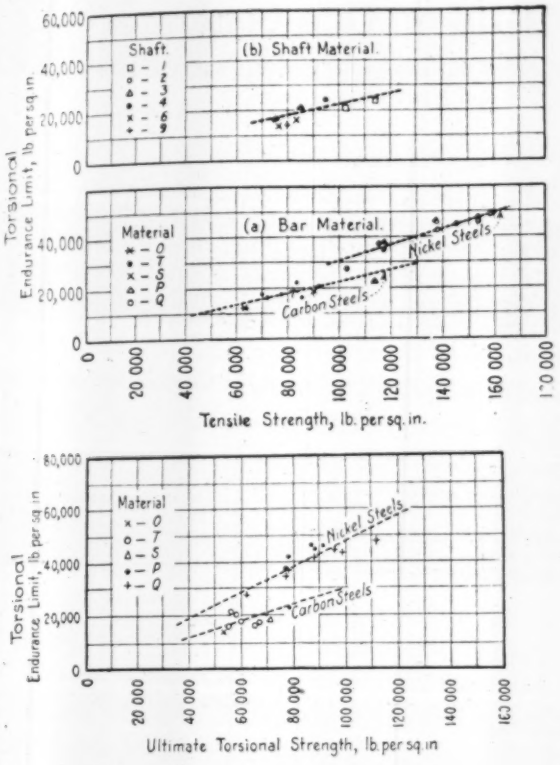


FIG. 5—TORSION ENDURANCE RATIOS

Upper diagrams show relation between torsion endurance limit and tensile strength. Lower diagram shows relation to torsional strength. The crank-shaft diagram represents a ratio of 0.22, as for carbon steel bar material.

or moderate proportional limit, the endurance limit is about equal to the proportional limit, while for high proportional limit the endurance limit is only about half. The ratio of endurance limit to proportional limit is conspicuously lower in low and medium carbon steels than in nickel steels of the same strength.

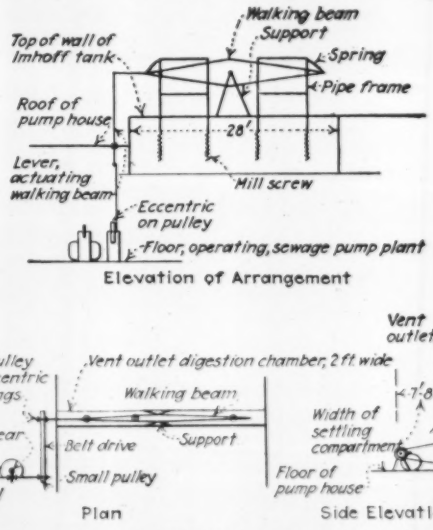
That endurance is not related to brittleness, or in other words to the property which causes failure of a notched specimen under impact, is shown by comparison of the reversed-bending and torsion endurance limits with the Charpy values, and also by the fact that the impact endurance limits depend only on the former. The impact endurance tests were made on notched bars, and here high-carbon steel having a Charpy value of only 2.9 proved superior in endurance to similar bars of low-carbon steel having a Charpy value of 23.6. It is concluded that, whether or not a machinery part contains abrupt change of section, its fatigue-resisting quality is independent of the impact value of the metal, provided the energy of impact is not so great as to cause fracture after less than about 1,000,000 blows.

Endurance Range—Some special experiments to supplement those already referred to were made to investigate the magnitude of the endurance range in various positions within the elastic range. With steels heat-treated so as to have proportional limit nearly twice their endurance limit, it was possible to vary considerably the position of the endurance range within the elastic range. From the results it is concluded that the variation of the endurance range within the elastic range is slight. Even when the stress oscillates between zero and a positive value, the endurance range is apparently not more than about 10 per cent less than when the stress oscillates between equal positive and negative values. It is further concluded that ***within the elastic range the endurance range may be assumed to be practically twice the endurance limit.***

Mechanical Agitation of Scum in Vent Chamber of Imhoff Tanks

CONTINUOUS agitation of the scum forming in the vent chambers of the Imhoff tanks treating the sewage at Newton, Kan., prevents "boiling over," the bugaboo of so many operators of sewage plants. W. C. Conrad, mayor of Newton (not an engineer) and Mr. Bachus, a local machinist, have devised a motor-driven walking-beam arrangement carrying four mill-conveyor screws upright in the vent chamber. A. P. Learned, of Black & Veatch, consulting engineers, who designed the plant (see *Engineering News-Record*, Feb. 10, 1921, p. 249) states that such satisfactory operation was secured that a similar arrangement has been installed in the plant at Enid, Oklahoma.

The Newton plant consists of a pumping station, Imhoff tank, sprinkling filters, final settling tank and sludge drying beds. Because of the strong sewage, with the consequent large amount of gas generated in its digestion, and the fact that the walls of the vent chamber



WALKING BEAM DEVICE FOR AGITATING SCUM IN GAS VENT OF IMHOFF TANK

The pipe frames supporting the four screws are counterweighted and fastened to the walking beam at one point so that each screw has the same travel. Operation was unsatisfactory when the travel was unequal.

are only 1 ft. above the level of the outlet weir, the tank often boiled over. The mayor's idea in agitating the scum was to give a free passage of gas and to prevent its hardening, which entrained the gas.

The walking beam, of 1-in. angles, well laced and braced, is mounted over the center of the vent chamber parallel to the long dimension. Fastened to each end of the beam is a frame of 2-in. pipes mounted at one point and held by a spring so that each frame rides at the same angle as the walking beam is raised and lowered. To the bottom of each frame are attached mill screws 8 in. in diameter and 4 ft. long. To one end of the walking beam is attached a lever actuated by a large pulley belted to a smaller pulley run in turn by a shaft driven by a worm gearing mounting on a motor driving one of the sewage pumps. The gear and pulley arrangement reduces the speed of the motor so that the walking beam operates at four to five cycles per minute and the travel of the screws up and down is 12 to 18 in.

Why Steel Forms Were Successful on One Concrete Job

Construction Typical of Many Others Showed That Use of Steel Forms for Concrete Floors and Columns Made for Speed, Economy and Neat Appearance

By Raymond C. Reese
Chief Engineer, Building Products Co., Toledo, Ohio

IN THE construction of a new group of reinforced-concrete buildings for the Hupp Motor Co., at Detroit, Mich., steel forms were used so successfully for the floors and columns that the experience there seems to be of especial value to those who wish more light on the availability of this type of formwork.

The group consists of two four-story parallel buildings of the flat-slab type, each 73 ft. 6½ in. wide by 396 ft. 9 in. long, numbered 9 and 10, respectively, and a third building, No. 11, in which beam-and-girder construction was considered preferable to flat slab because of the machine loads and spacing. This latter building is 53 ft. wide by 339 ft. 1½ in. long, four stories high. • The first story is 24 ft. 6 in. high plus a 4-ft. track depression, which necessitated very long shores. Even with beam-and-girder construction it was found both feasible and economical to use the same forms for the solid slabs between the beams—a rather unusual arrangement but since repeated on other work.

The decision of the general contractors to sublet the formwork to steel form erectors was made on a competitive price basis, as compared with wood centering. There was a saving of about 10 per cent in favor of the steel forms. One of the first steps was to make complete working details showing the arrangement of steel panels, location of shores, run of stringers, detail of forms for drop heads, etc., which means that all preparations were made in advance to insure an average daily progress that would complete the work in the scheduled time. The layout required for Building 11 is shown in Fig. 1.

Fig. 2 shows a typical panel. Shores of 4 x 4's were set up at proper intervals (averaging one to every 30 sq.ft. of floor) with 2 x 8-in. stringers resting upon shoulder blocks, fastened to the shores. Wedges were interposed to allow for leveling up. The arrangement of buttons is particularly worthy of note. These can be turned up on the outside of the stringers to hold them in place or can be rotated about the bolt out of the way, to permit easy stripping of the stringers.

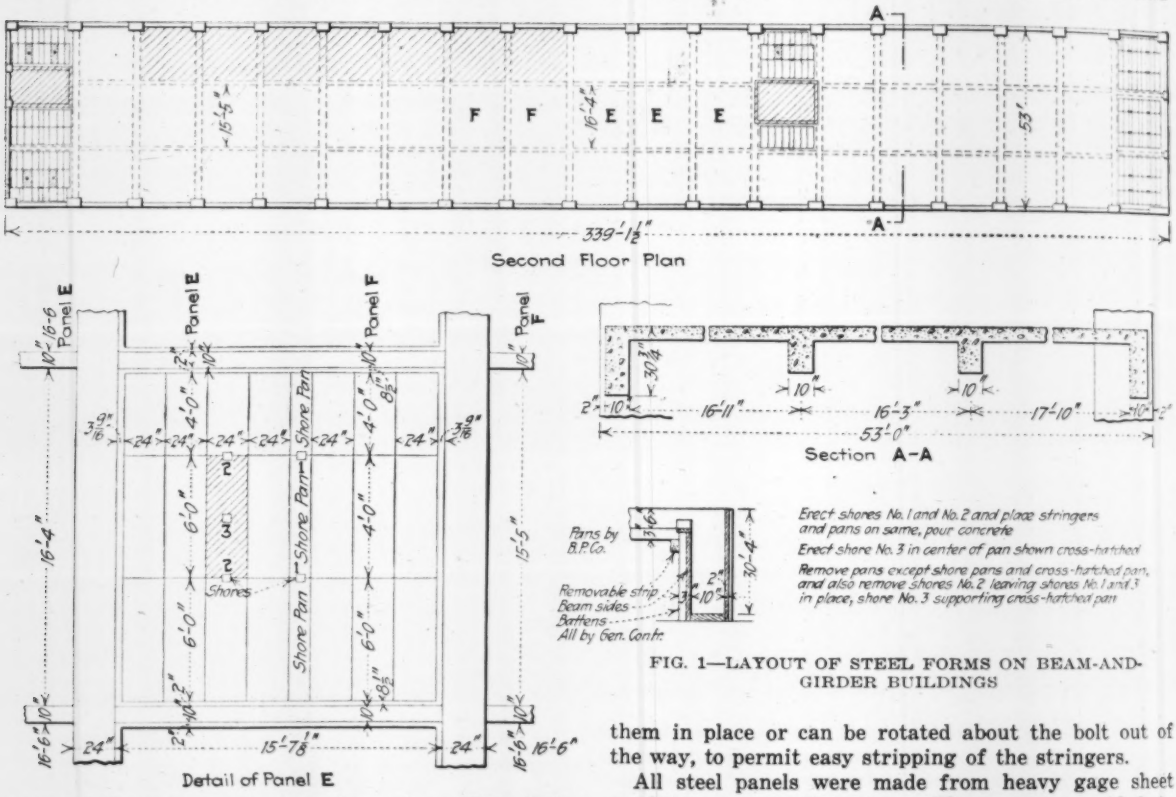


FIG. 1—LAYOUT OF STEEL FORMS ON BEAM-AND-GIRDER BUILDINGS

All steel panels were made from heavy gage sheet steel to prevent distortion. They were provided in widths of 1, 1½ and 2 ft., and in lengths of 4 and 6 ft., thus making only a few sizes to stock and handle, and likewise proving very feasible and adaptable in actual practice. These panels conformed to the floor layout within a few inches, and variations were filled in with a strip of wood. The 1-ft. steel panel had open ends so that shores could extend up into the panels and remain there for permanent shoring as shown in Fig. 3. The other steel panels were made with solid ends and all of the steel panels or forms were manufactured with stiffening ribs arranged at short intervals. Two or three days of good weather allowed the stringers and intermediate steel panels to be stripped and used on the next set-up leaving shores and permanent shore panels to support the floor until the deck above was poured.

FIG. 2—CLOSE-UP OF UNDERSIDE OF STEEL FLOOR FORMS ASSEMBLED

Progress of Work—The storage site where the material was to be stored was not particularly convenient being some little distance from the site of the buildings and separated by a railroad track over which a large amount of switching took place with consequent delay to the trucks. This was an unavoidable handicap but did not interfere with the completion of the work within a specified time.

The contractor first placed the concrete floor on the ground, thereby affording a firm foundation upon which to start shoring. The first operation was to build drop panels of wood to form plinths above the column caps. The columns were circular, spirally hooped, with a flaring cap and were formed with steel column molds. Experience has proved that the only way to obtain proper alignment and to reduce erection cost is to put up the drop panels in the form of strongly braced towers which are aligned in both directions and wedged up to grade. After these are firmly braced in position they establish reference points between which the steel panels are placed. Fig. 5 shows very clearly the arrangement of these towers.

On Sept. 11, 1922, the first steel forms or panels were placed for Building 9, shown by Fig. 4, and the erection schedule calling for completion of the concrete work by Nov. 11 necessitated strict adherence to the established routine. The steel form area shown in Fig. 4 is the result of part of the first day of form placing. Fig 5, taken two weeks later, gives a good conception of the entire layout and shows the tower for the second floor of Building 9 practically completed. It also shows towers being started on the second floor and part of the first floor on Building 10, while on Building 11 the first floor is entirely completed. This represents only two weeks progress after the first forms were placed. Two weeks later the third floors of Buildings 9 and 10 were started and the second floor of Building 11 was about finished. This progress schedule was carried forward steadily throughout the entire job.

On Nov. 11 the last concrete was placed. The chart which was prepared by the contractors for their progress schedule on Sept. 11 called for approximately 240 yd. per pouring day and made no allowance for mishaps or other contingencies. The usual difficulties were encountered, such as delay in the delivery of cement (the railroads being fearfully tangled up at that time), loss and replacements of labor, delay in pouring owing to trouble with cement plant and delays in trucking the material from the storage site; notwithstanding these handicaps the work was completed on the exact date predicted.

This job typifies co-operation between the contractor and the subcontractor as it involved a fairly good sized area of buildings and was carried through by all parties to their mutual satisfaction, and it will serve better as a typical illustration of steel formwork than one on which unusually favorable conditions enabled extremely low costs and unusually rapid programs to be attained.

The subcontractor's form-setting crew for both steel pans and column work, including handling of all slab shoring, fabrication and handling of drops, consisted of 20 men and a superintendent. This crew carried the job through to completion and formed 300,000 sq.ft. of floor in 60 calendar days. The attainment of such speed as shown in this particular instance is not an extraordinary accomplishment in the writer's experience. The explanation of maintenance of the speed schedule is based upon the fact that steel forms make possible the use of considerably less shores than are used with most forms; and the most important fact, that the steel form crew was trained man by man to perform certain special operations, each with the utmost speed. Because one man or set of men have just one thing to do they become expert and attain the highest possible speed in the performance of their special function. By this it is possible to obtain the highest speed from labor employed over the job and to use less men on a job of this character than would be necessary with other systems of forming.

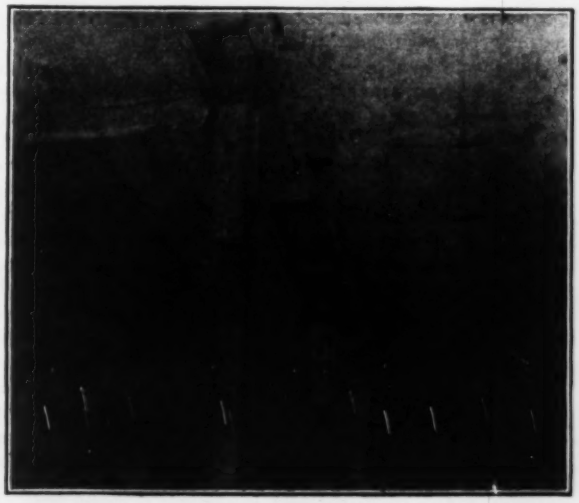


FIG. 3—PERMANENT SHORING AND SHORE PANELS IN PLACE

One of the points encountered on all industrial buildings is the placing of inserts for fastening shaft hangers, sprinkler pipes, etc. When wood forms are used, these are screwed or nailed down. Metal forms have made possible the use of mastic cement which fastens the insert firmly to the metal forms. A large number of inserts were used on the Hupp job and by the use of this cement it was possible to place inserts at a cost of 1½c. each.

Construction Precautions—Great care was taken to see that materials were delivered to proper points and neatly piled ready for use. As soon as forms were stripped they were moved to the side wall of the building ready to be carried to the next point, loaded on buggies which were elevated by a boom on the tower. If this movement of forms had been only from floor to floor it would have simplified movement considerably and greatly reduced the handling charges, but as it was, the forms were moved in turn from building to building as progress required.

Emphasis has been made of the point of centering towers to line and grade and having them securely braced. A first glance would see a possible economy in the formation of less substantial towers, but experience has proved that the care and attention given to the construction of well braced towers, accurately lined, is a worth-while ultimate economy. Another point of economy consists in running long lines of shores at one time. It is expensive to spot a few shores here and there, but when a reasonable run can be pushed through at one time, the unit costs are cut considerably. The making of shores can be studied and systematized just as carefully as production work in a large factory. This is especially important when it is considered that a nominal amount of shores run well into the thousands in quantity. Adequate ribbon bracing of all shores is also important in the obtaining of a neatly finished job. It takes but little longer to do this and in the end it pays for itself.

One of the big economies of the steel form system as a whole lies in the small amount of lumber required. It is generally accepted that forms for a flat-slab job made up entirely of lumber require from 3 to 3½ ft.-b.m. per square foot of contact area, while with the system of steel forms used on this job, the requirements averaged ⅓ ft.-bm. On small jobs, where the number of re-uses is limited, a little more will be required, while on very large jobs it is possible to use a little less.

Furthermore, none of the lumber used in the steel form system comes into contact with the concrete and is consequently in good condition and has a very high salvage value. In fact it can be used indefinitely from job to job merely at the expense of freight and handling. On the Hupp Motor Group, the lumber was furnished by the general contractor who had already placed partial orders for material required, but was fabricated by the subcontractor.

The partial layouts, Fig. 1, show how nearly the forms covered the area to be formed and how little filling in was required. They give a good idea of the adaptability of the system. It has proved much more successful in actual practice than one would expect from a cursory examination. The chief matter of adjustment is obtained by using "pads" or fillers on the drop heads to take up the play between the actual drop as designed and the opening left by the panels. At these points practically all the slack is taken up. At spandrel beams it is well to follow the details indicated, leaving a few inches of filling in between the actual beam side and the first panel, both to facilitate the stripping of the forms and to give another point at which to take up play. This detail has practically become standardized.

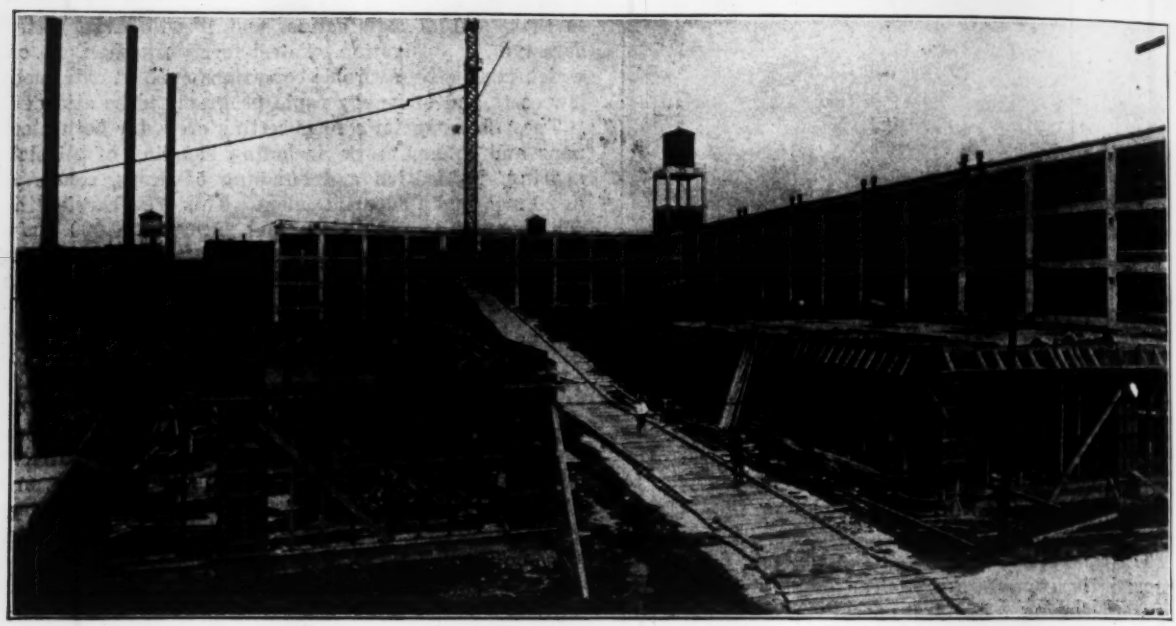


FIG. 4—SET-UP OF PANS ON STRUTS AT BEGINNING OF CONSTRUCTION

Conclusions—The following conclusions are the result of the writer's experience with the system:

(1) On buildings of such size that a sufficient area for one set-up is obtained with an area of forms that will permit of four or more re-uses, steel forms can be used more economically than wood forms, and as the number of re-uses increases, the economy increases.

(2) But little filling in between forms and spandrel beams or drop panels is required.

(3) No difficulty has been experienced due to the combination of steel forms with wood beam and drop panel forms. A little forethought in the design of the wood forms is all that is required.

(4) Inserts are readily and securely held by mastic cement and can be placed at a minimum expense.

(5) Steel forms produce a ceiling that is much smoother than can be obtained with the use of ordinary wood forms.

Whether or not steel forms are applicable to the particular construction is a question involving the calculation of forming cost on the particular job, considering especially the following headings:

(1) Number of Re-Uses to Which Forms Can Be Put on a Particular Job. This involves, among other items, the area of forms required in one set-up. Usually not less than 5,000 to 10,000 sq.ft. is desired at a time, and sometimes even more, depending upon the capacity of the concreting plant.

(2) Cost of Lumber. This is a highly influential factor in determining whether a job is one for steel forms or not, as steel forms require from 50 to 60 per cent less lumber than other methods of forming. Where lumber is high, the ultimate economy in the use of steel forms is easy to perceive. Steel forms can be used economically on a much smaller floor area where lumber is high than is possible where lumber is appreciably cheaper.

(3) Scarcity of Labor. The fact that we have been able to form large jobs and keep up with a definite progress schedule, with the use of very few men, has enabled us to disregard the labor situation to some extent, as we carry a regular force which can be kept busy at all times.

(4) Quality and Finish of Work Required. This particular item is one which is the subject of a great deal of discussion. On this particular job we were obliged to furnish a high class of finish on the concrete, which in our opinion would have been impossible with other methods of forming.

The general contract for the Hupp Motor Group was let to the Everett Winters Co., of Detroit, Mich. The subcontractor for formwork was the Building Products Co., of Toledo, Ohio. The Blaw-Knox slab forms were used.

FIG. 5—PROGRESS ON HUPP GROUP AFTER TWO WEEKS OF FORM LAYING
Note towers supporting the column head panels

Mississippi Bridge at St. Paul

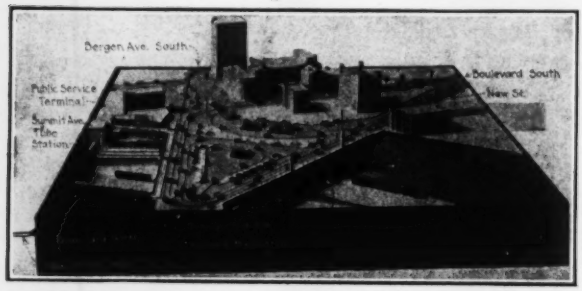
An engineering report is soon to be made on the proposed bridge over the Mississippi River at the new Ford plant, connecting the cities of St. Paul and Minneapolis. A commission to consist of at least five members was authorized by the last legislature, and the commissioner of highways was appointed chairman. The other members of the commission include the president of the council of each city and the city engineer of each city. This commission delegated the work of preliminary surveys and report to the two city engineers, N. W. Elsberg (Minneapolis) and George M. Shepard (St. Paul). Surveys have been made and a report will soon be made to the commission. The law provides for the issuance of $800,000 in bonds by each city to defray the cost of the bridge.

Bridge Plaza Plans Successfully Presented by Aid of Model

Complicated Layout Made Clear by Use of a Model—Mechanical Arrangement to Show Traffic Movements

THE USEFULNESS of a model in presenting proposed development schemes to the public is well demonstrated in the case of the proposed Hudson County Bridge Plaza at Summit Ave. in Jersey City, N. J. The Hudson County Boulevard is the one north and south thoroughfare on the west shore of the Hudson River opposite New York City. It is one of the most important thoroughfares of the Metropolitan District, used as the Lincoln Highway carrying all the traffic south and west from New York City. Its importance will be greatly increased when the vehicular tunnel now under construction under the North River between Jersey City and New York is opened.

The alignment of the boulevard is fairly straight until it reaches the point, in the vicinity of Summit Ave., where it is carried over a depression, in which the tracks of the Pennsylvania and Hudson & Manhattan railroads are located, on a three-span structural steel deck bridge 342 ft. long and 60 ft. wide carrying a 40-ft. roadway and two 10-ft. sidewalks. The height



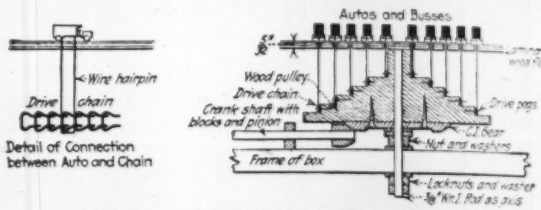
MODEL OF THE HUDSON COUNTY BRIDGE PLAZA

of the roadway over the tracks is 50 ft. The improved roadway beyond the bridge is 60 ft. in width. The existing bridge was built in 1894 when the boulevard was no more than a bridle path. Due to heavy traffic there is an excessive vibration throughout the entire structure, making necessary an immediate reconstruction.

In a northerly direction from the bridge the roadway curves to the left from the abutment through 51 deg. Likewise, going south, it begins to curve to the right immediately as it leaves the south abutment through 77 deg., then follows one full city block of tangent and another turn left through 46 deg., thus forming in all a very tortuous alignment. In this elbow curve is the center of great traffic activity which is due, in large measure, to the movement of passengers to and from the Summit Ave. station of the Hudson & Manhattan "Tubes," which is located just east of the south end of the bridge. In 1922 this station handled 24,000,000 passengers. This figure gives a fair indication of the magnitude of traffic in this section.

The great bulk of this passenger traffic is handled to and from the station by buses, private cars and taxicabs along the boulevard. The surface car traffic from Bergen Ave. does not directly affect the situation as the cars do not come out onto the boulevard. All the bus lines with the exception of the Central Ave. line terminate near the south abutment of the bridge discharging and loading passengers on the bridge and around the curve immediately adjacent thereto. This is for the convenience of passengers in reaching the 15-ft. passageway which is the only avenue of access from the boulevard to the station. The buses from the north discharge passengers on the bridge and turn around in the two narrow streets forming Journal Square. The Bergen Ave. line uses these streets also but turns at the street intersection north of the bridge which is also the turn-around for buses from the south on the boulevard.

The two principal bus lines north and south on the boulevard carry monthly approximately 1,600,000 pas-



METHOD OF MOUNTING THE MOVING PARTS

sengers. To complicate the situation there is the through and local travel on the boulevard. The maximum eight-hour count of vehicles over the bridge including the buses is 15,000. These factors, the tortuous alignment of the boulevard, the narrowness of the bridge roadway, the inaccessibility of the station and the enormous growth of travel have caused a traffic congestion comparable in importance and magnitude to the larger traffic problems of the Metropolitan District.

The Proposed Rearrangement — In correcting the alignment of the boulevard by projecting a new street forming the hypotenuse of a triangle to divert part of the traffic from the principal turn of the boulevard where the traffic jam occurs, all the traffic difficulties of the section are corrected and essential facilities are readily evolved. The new street continues across the railroad cut and intersects the present roadway just beyond the northerly abutment. The two roadways over the tracks form the sides of an A-shaped bridge plaza 200 ft. in width at the northerly abutment or apex, 525 ft. in width at the base, the length or altitude being 465 ft.

Traffic Movements—This "A" shape made possible a one-way movement in traffic control. Within this space three large platforms are placed to separate the traffic south-bound on the westerly leg and north-bound on the easterly leg or roadway of the bridge. The two platforms parallel with the roadways form a center plaza wherein the north-bound vehicles or buses can be drawn away from the through traffic. Passengers are to be unloaded on the one platform and loaded from the other, the vehicles turning within the area. The large platform forming the cross-bar of the "A" is used as a receiving and unloading platform for south-bound passengers. The buses are operated along the lower or curved side of the platform. The upper or straight edge of the platform will be used for private vehicles from the north turning with the general traffic movement. The sides of this big platform can be used for unloading passengers from vehicles continuing north

and south beyond the plaza. There is parking space in the center between platforms and along the side of the platforms for taxicabs and momentary stops of private vehicles. Private vehicles can also park along the roadway sides of the platforms.

Stairways lead from the three island platforms to two longitudinal and one main or transverse passageway built directly underneath the bridge floor. The transverse passageway is in line with the existing passageway to the station and will be built underneath it to the width of 20 ft. Other stairways from the various corners of the plaza connect with these passageways to make it possible to reach the station or the three island platforms from any point on the surface without crossing the roadways. Hudson County and Jersey City authorities jointly will remove the buildings in Journal Square, thus giving Bergen Ave. proper access to the boulevard.

Plaza Model—After the preliminary plan had been approved by the Board of Chosen Freeholders it was found that there was considerable misinterpretation and misunderstanding of the workability of the plan. To correct these false impressions a mechanical model was made so that the entire project would be visualized. The model was made to scale of 1 in. equal to 20 ft., the scale of the plan of the general layout. From this plan the buildings, roadways, piers, etc., were readily superimposed on a large piece of heavy cardboard on which were drawn also the lanes of all lines of traffic and the plan of the mechanical effects. The roadway of the model is made of laminated wood about $\frac{1}{8}$ in. in thickness. Slots were cut in the roadway in the center along the principal lines of traffic movement making loops of each separate route. Under the ends of the roadways were stepped sprocket wheels or cone pulleys so set that the face of each step came directly under the turn in the corresponding slot in the street. At the minor changes in direction stepped fixed guides were used instead of sprocket wheels. The main sprocket was geared to a crankshaft extending outside the frame of the model. When the wheels and guides were in place chains were fitted to them, one chain under each slot in the street surface. When the chains were adjusted hairpins were secured to each chain at intervals along its length by sticking the ends of the hairpins through the links of the chain. These pins were cut off about $\frac{1}{2}$ in. above the street surface and a tiny pressed pewter automobile was secured to the ends of each pin by sticking them in hot sealing wax poured into the body of the car. The automobiles on each line were colored differently to distinguish the separate traffic routes. Other automobiles were secured directly to the street surface showing position of parked cars.

When the whole model was assembled it was possible, by turning a propelling crank, to cause all the lines of automobiles, buses etc., to move around the plaza along their proper routes showing continuous movement without interference.

The buildings were made of cardboard with the architectural features drawn in elevation. Only the most important buildings of the section and those buildings necessary to show the relative position of the new street and the bridge plaza were made a part of the model.

The improvement is being carried on by the Board of Chosen Freeholders through the office of County Engineer Frank J. Radigan. The plans were prepared and the model was made in the office of A. Burton Cohen, consulting engineer, New York City, assistant engineers, Robert L'H. Tate and Harry K. Wilson.

Why Sacramento Garbage Collection Bills Are Presented by Agents

IN COLLECTING from the householders of Sacramento, Calif., the monthly charge which the city makes for removing garbage, the bills are presented at the door by employees of the city. Three collectors have been found adequate, with occasional aid from the head of the department, to collect the monthly bills for the entire 15,000 premises which subscribe for the garbage removal service. Owing to multiple payments at real estate offices, etc., only about 12,000 addresses have to be visited each month by collectors. Solicitation in person is made rather than mailing the bills because the additional cost is more than offset by the lower percentage of bad bills. Another advantage of personal solicitation is that the collector can report attempts to evade proper classification, failure to observe sanitary regulations, etc.

With a minimum charge of 50c. per month for weekly removal from one 20-gal. garbage can, the average collection per address is slightly over $1 and the total collection $12,500 per month from the 12,000 addresses.

Collectors carry a carbon copy attached to each bill. At addresses where no one is found at home the collector uses a rubber stamp to mark the bill "Pease remit by check with bill attached, or bring to City Hall before the first of the month." After repeated failures to make colletcions the collector leaves a bill marked "If this bill is not paid within three days service will be discontinued." Under this system only a fraction of 1 per cent of the bills go unpaid

Forests Prevent Silting of Reservoirs

Abstract of paper on Soil Erosion and Forest Cover in Relation to Utilization of Water Power, with Special Reference to the Southeast, presented by W. W. Ashe, Assistant District Forester, U. S. Forest Service, before the Southern Appalachian Water Power Conference.

IF THE ENORMOUS resources of our rivers are to be adequately developed it must be through a series of storage reservoirs such as have been tentatively located on the upper regions of some streams. As the value of such reservoirs depends largely upon their life and the maintenance of their storage capacity, erosion of soil is the all-important factor in determining the number of years which will elapse before the fertile soil and earth removed by heavy rains from the land in their catchment areas will fill them, gradually in most cases, but surely if any erosion takes place. Erosion is not a natural condition for such streams as lie above 1,500 ft. altitude, and in many cases it is entirely due to the removal of the protective cover of the forest with its litter and humus.

Hydrographers claim that forests have little effect on stream flow, but this is to be questioned except in the regions of sandy soil where the forest influences are usually at a minimum. These influences rise to a maximum in the Sierras of California, in the southern Appalachians, and in the southern Piedmont, where erosion is an important factor. Nor does grass cover take the place of forest cover, because grass cannot be adequately maintained without periods of cultivation and consequent erosion, and moreover a grass cover lacks the permeability of forest cover with its deep root zones and channels resulting from the decay of roots.

Endurance of Steel—Second Illinois Report

Correlation of Endurance and Heating—Tests on Combined Tension and Bending—Goodman's Law Not Verified

A DEFINITE endurance limit for wrought steels was established in the early series of tests carried on at the University of Illinois as a co-operative research between the Engineering Experiment Station of the University, the National Research Council, Engineering Foundation, and the General Electric Co., as reported in the Illinois Bulletin 124, published two years ago. Extensive additional tests have just been reported on in Bulletin 136 of the station, by H. F. Moore and T. M. Jasper. These additional tests con-

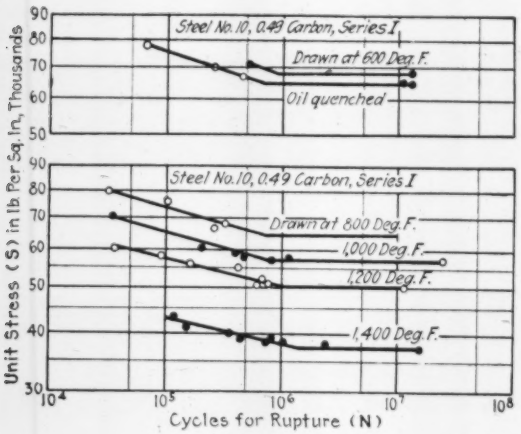

Steel No. 10, 0.49 Carbon, Series I
Drawn at 600 Deg. F.
Oil quenched
Steel No. 10, 0.49 Carbon, Series I
Drawn at 800 Deg. F.
1,000 Deg. F.
1,200 Deg. F.
1,400 Deg. F.
Unit Stress (S) in lb. Per Sq. In., Thousands
Cycles for Rupture (N)

FIG. 1—TYPICAL REVERSED-BENDING CURVES
Endurance limit decreases with increase of drawing temperature from 600 to 1,400 deg. F.

firm all the results indicated in the prior report, and in addition deal at considerable length with repeated stresses of combined tension and bending, in which case the stress in the outer fiber of the metal varies from a high tension to a low compression or from a high tension to a low tension, instead of varying between equal tension and compression values as in the previous reversed-bending tests. The results indicate that the so-called dynamic law of Goodman does not hold, but that higher endurance values are obtained than would follow from this hypothesis.

In the recent work carbon steels ranging from 0.02 to 1.20 carbon, and two chrome nickel steels with about 3½ per cent nickel, were tested. Reversed-bending tests were carried out on a specimen supported at both ends and loaded in the middle, while rotated at a speed ordinarily 1,500 r.p.m. Substantially no effect on the results was found by changing the speed to as low as 200 r.p.m. or as high as 5,000 r.p.m. The torsion tests were made in machines of two different types. In all cases the specimens were cut from the material longitudinally (in the direction of rolling).

Endurance Limit Confirmed—The conclusion from the earlier tests that wrought ferrous metals have a definite endurance limit—a stress below which the material will stand an indefinitely large number of reversals—is confirmed by the more recent tests. All the plots such as those of Fig. 1 (reversed bending)

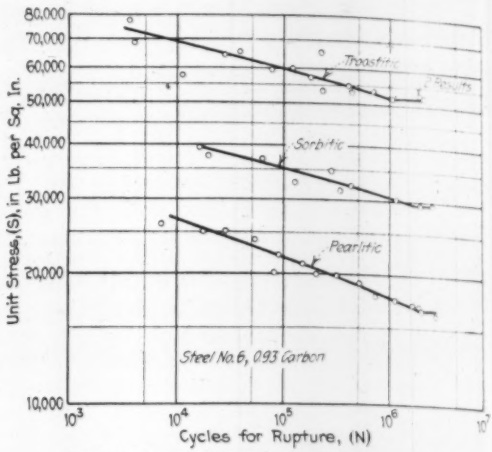
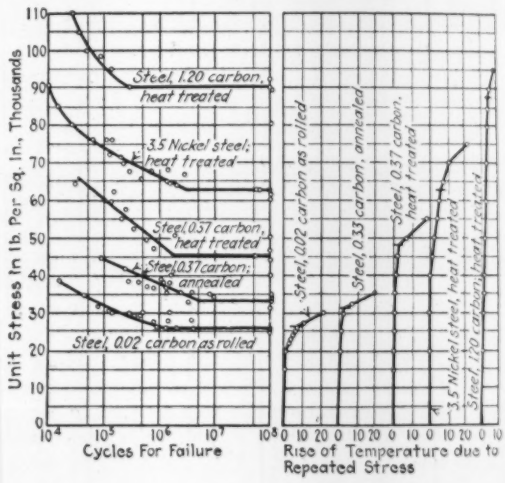


FIG. 2—REVERSED-TORSION CURVES

and Fig. 2 (reversed torsion) show a sloping part changing sharply to a horizontal part (in plottings on double logarithmic paper). Special search was made to discover whether the horizontal part of the curve shows a tendency to drop at very high values of reversals, and a number of tests were run to about one billion reversals at values just below the endurance limit deduced from a smaller number of reversals. No evidence of a lowered endurance limit at this very high number of reversals was found.

Heating Limit Identical With Endurance Limit—Complete confirmation was obtained of the previously


Steel, 1.20 carbon, heat treated
3.5 Nickel steel; heat treated
Steel, 0.37 carbon, heat treated
Steel, 0.37 carbon; annealed
Steel, 0.02 carbon as rolled
Unit Stress in lb. Per Sq. In., Thousands
Cycles For Failure
Rise of Temperature due to Repeated Stress

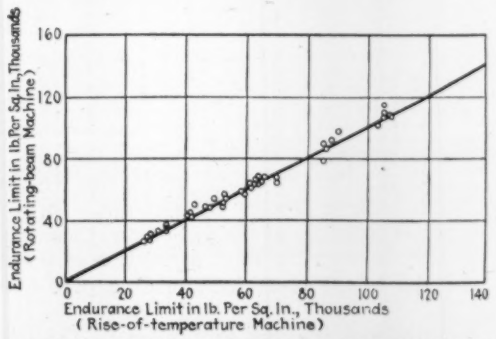

Endurance Limit in lb. Per Sq. In., Thousands (Rotating-beam Machine)
Endurance Limit in lb. Per Sq. In., Thousands (Rise-of-temperature Machine)

FIG. 3—CORRELATION OF ENDURANCE LIMIT AND HEATING LIMIT

developed fact that the endurance limit may be determined by noting the break in the rise-of-temperature curve in a series of stress reversals extending over only a few minutes. The upper diagram in Fig. 3 shows side by side the endurance curves (in this case plotted on simple logarithmic paper) and the corresponding heating curves, which show a break at the endurance limit. Fuller proof of the identity of the two points is given by the lower diagram, which represents a composite plot of all the tests so far made, each point being plotted with endurance limit as ordinate and heating limit as abscissa. None of the points departs materially from the straight line of equal values.

Strengthening Effect of Overstress—Some specimens which had stood 100,000,000 cycles without fracture, under stress just below the endurance limit, were retested under higher loads, and many of them ran up to 50,000,000 cycles or more although the stress in certain

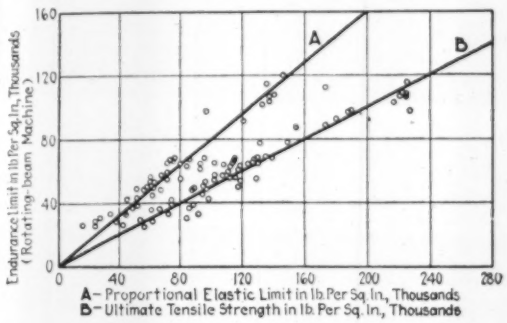


FIG. 4—CORRELATION OF ENDURANCE LIMIT WITH ULTIMATE STRENGTH

Left-hand curve shows the imperfect correlation with elastic limit.

cases was as much as 20 per cent above the endurance limit of the material in its original condition. This strengthening effect was especially noticeable in 0.37 carbon steel, normalized.

Relation of Endurance Limit to Ultimate Strength—From the two curves in Fig. 4 it may be seen that the endurance limit is very closely correlated to the ultimate strength of the steel, and only quite imperfectly to the elastic limit. This also agrees with the indications of the earlier tests. In this connection, however, the second report gives the following necessary caution: "The materials engineer should beware of regarding any single property of a metal—elastic limit, tensile strength, endurance limit, hardness, ductility, notched-bar value, etc.—as a complete indication of the usefulness of a steel. Static strength, resistance to impact, ductility under overstress, and resistance to repeated working loads are all important."

Effect of Overstress—In a number of tests the endurance specimen was first subjected to a few applications of direct tensile stress. As exhibited by the curves in Fig. 5, this preliminary stressing had no effect on the endurance test so long as it was well below the proportional limit, but above that limit it reduced the endurance 20 per cent.

Effect of Heat Treatment—When the temper of a hardened steel specimen is drawn, its endurance limit is not much affected until the drawing temperature exceeds 600 deg. Higher drawing temperatures pro-

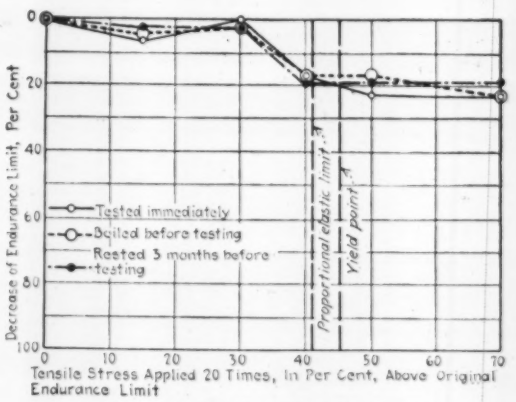


FIG. 5—REDUCTION OF ENDURANCE LIMIT BY PRELIMINARY OVERSTRESSING

duce a progressive decrease in endurance limit, as illustrated in Fig. 1. For nickel steel, both ultimate strength and endurance limit fall off slightly even with low temperatures of draw.

Combined Bending and Tension—An extended investigation of endurance under a range of stress other than complete reversal was begun during the past two years. The tests were made upon a rotating cantilever specimen loaded at its outer end, and stretched longitudinally by a heavy spiral spring bearing against a collar on the specimen. The endurance curves obtained proved to be exactly like those for reversed bending, but the endurance limit had a different value. The steels tested were a 0.53 carbon steel and a 3½ per cent nickel steel.

The results for the nickel steel, annealed, are reproduced in Fig. 6, where they are plotted in connection with a Goodman diagram. Professor Goodman, of Leeds, developed a hypothesis on the assumption that the varying component of stress has twice the effect of a steady stress, and that fracture cannot develop unless the sum of steady stress and twice the varying stress reaches the ultimate strength of the material. The shaded diagram in Fig. 6 represents the Goodman hypothesis. The plotted circles and the curved line passed through them represent the Illinois test results on this particular material. In all the tests it was found that the curve of maximum stress approached the horizontal in the neighborhood of the proportional

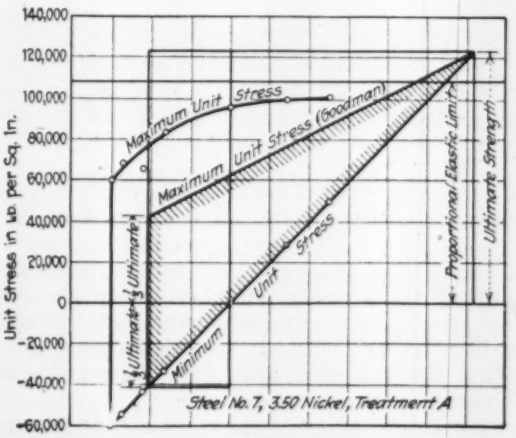


FIG. 6—GOODMAN DIAGRAM AND ACTUAL TEST RESULTS FOR 3½ PER CENT NICKEL STEEL

limit, while below the point of sharp bending the maximum-stress curve was not far from parallel to the minimum-stress line, in most instances.

A formula is proposed in the bulletin, to express the endurance limit (maximum stress) for any given ratio r of minimum to maximum, in terms of the endurance limit for completely reversed stress, S_{-1}:

$$S_r = \tfrac{1}{2}(r + 3)S_{-1}$$

The formula can be used only up to the limit at which the maximum unit stress reaches the proportional limit of the material; for most steels this eliminates ratios of minimum to maximum stress greater than zero. "Beyond the proportional elastic limit the static properties of the steel are the governing factors, rather than the fatigue properties."

Laying Large Cast-Iron Gas Main in Chicago

Work Expedited by Breaking Bell-Hole Material into Excavator Buckets and Calking with Air-Driven Tools

RAPID laying in Chicago last fall of 4½ miles of one of the largest gas mains in the country involved 7½-ft. trenches which were excavated at one cut with bell-holes predetermined and the material broken down into the excavator. Other features of the work were rapid calking by pneumatic hammers, cumulative testing of the line, reduction of the speed of the pipe-lowering lines by a double set of blocks and placing the pipe on the original, undisturbed bottom of the trench. The line was laid by the Peoples Gas, Light and Coke Co., on Crawford Ave. from Thirty-ninth St. to Forty-fourth St., on Forty-fourth St. from Crawford Ave. to Hamlin Ave., and south on Hamlin Ave. from Forty-fourth St. to Seventy-first St., as a new connection to the distribution system on the south side of the river from the newly completed plant at Thirty-fifth St. and the Main Drainage Canal of the Sanitary District of Chicago. The new pipe serves three purposes: (1) It takes care of the maximum capacity of the new plant, (2) it acts as a storage holder and (3) it will supply the south and southwest sides of Chicago for many years.

With a 3-lb. drop in pressure on the 48-in. main between the pumping station at the holder at Thirty-fifth and Crawford Ave., and with the different lines feeding east out of the 48-in. main, the new main will pass a maximum of 3,000,000 cu.ft. per hour. The pressure maintained at the pumping station is from 6 to 6½ lb. With a 1-lb. drop in pressure between the pumping station and Seventy-first St., a distance of nearly 5 miles, the 48-in. main will pass approximately 1,500,000 cu.ft. per hour.

The grade of the southwest side of Chicago drops gently to the north and all drainage flows to the Drainage Canal. It was decided that an easy grade should be given the 48-in. main to the north and that it should follow the natural contours of the ground. Two feet of cover was considered sufficient and by grading the line to the north, no drips would be necessary as the line would drain into the tunnel shaft at Thirty-ninth St.

All underground work was taken care of in advance, arrangements being made with the city water-works department to lower the mains deep enough to allow the 48-in. main to pass over them. A 30-in. main was cut and lowered 8 ft. by the insertion of 45-deg. bends. Telephone conduits and high voltage wires were moved out of the path.

An accurate survey was made of Hamlin Ave. along the route of the main and a profile map was made showing obstructions. The proposed line was laid out on this profile map and the grade established. Test holes were dug at each street intersection so that an accurate knowledge of the obstructions would be available and on record.

Because the south end of the job was on the highest elevation, and the territory at the north end near the Drainage Canal was open country, having a gumbo soil, very soggy in the spring of the year, it was decided to start at the south end.

Nash Brothers, the contractor for all work but the calking, sublet the excavation of the trench to W. C. Thorne, Oshkosh, Wis.

FIG. 1—THREE COMPRESSORS FEED AIR UNDER 100-LB. PRESSURE INTO HEADER LAID ALONG TRENCH
As high as fourteen sets of calkers and twenty-six hammers worked from the header line. The compressors supplied a maximum of 210 cu.ft. of air per minute.

An excavator with auxiliary cutters and buckets for the wide trench averaged about 200 ft. per day, while the average of 186 ft. of pipe laid, the speed maintained up to Aug. 1, is believed to be a record for 48-in. gas or water main. After this time the progress was slower as the line paralleled the trench of another underground utility making it necessary to substitute a dragline for the excavator.

Including the expansion of the earth from the trench the excavation runs about 2 cu.yd. per lineal foot. The position of bell-holes was determined ahead of the excavation and men with bars and shovels cut out the recess, throwing the material into the buckets of the excavator, thus saving the labor of throwing the material out of the trench. Due to a 43-day period of dry weather in Chicago only single pipe-trench braces were required, the clay gumbo standing up well.

To lower the pipe slowly into the ditch and to assist in lining it straight, the single line on the hoist drum was reduced by means of a double set of blocks so that 1 ft. on the drum was reduced to a 2½-in. drop at the pipe. A 10-ton caterpillar crane followed closely behind the excavator. It took 6 min. to lift the 48-in. pipe from the bank, place it in the trench and drive it

FIG. 2—BREAKING BELL-HOLE MATERIAL INTO EXCAVATOR

Position of bell holes was predetermined. With the auxiliary cutters the excavator dug a trench 7 ft. wide.

home. Extreme care was taken in laying the pipe, each length of which weighs 4 tons. The trench was dug to grade, and the 4-in. blocking so laid that the top was on grade, making the whole pipe, with the exception of the bell, rest on the original, undisturbed bottom of the trench. Constant engineering supervision was needed to carry out this plan. Levels were taken on the ditch as the excavator worked, on the blocking before the pipe was laid and on the pipe line after laying for a permanent record.

The company maintains its own machinery and crew for calking. Immediately after the pipe was placed in the trench, the bell-holes were trimmed in preparation for the calkers. At no time during the progress of the work were the calkers more than twenty-five joints behind the last pipe laid. Joints were 5 in. deep and calked with 3 in. of wool yarn and 2 in. of lead wool. Calking was done by pneumatic hammers, two men to each joint. It required 8 lb. of wool yarn and 126 lb. of lead wool per joint. Two men averaged two joints per day.

Compressed air was furnished by three portable compressors capable of supplying a maximum of 210 cu.ft. per minute each at 100-lb. pressure. A header line laid along the trench was fed by two compressors. At times as high as twelve sets of calkers and twenty-six hammers worked from this header line. The header line was run about 600 ft. ahead of the point where the calkers worked, and, by aid of an extra compressor, two compressors were always connected to the line while one was being moved ahead. By this arrangement the calkers were never held up waiting for air while the compressors or the header line was being moved ahead.

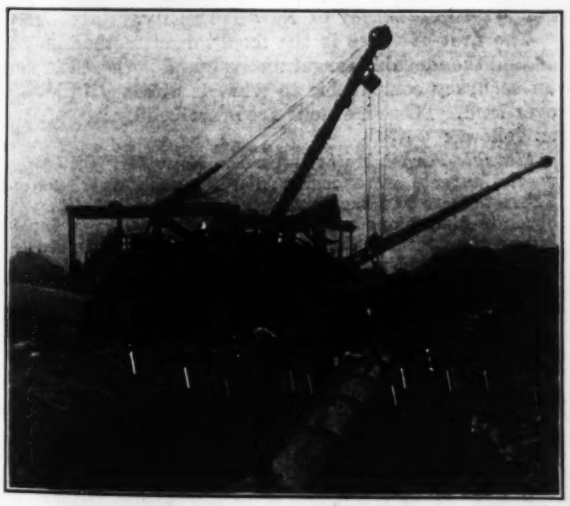


FIG. 3—EXCAVATION WITH DRAGLINE AND PIPE-LAYING WITH TRACTOR-MOUNTED CRANE

As precautionary measures against ground or surface water it was decided to have on the job three pumps having a capacity of 50 gal. per minute each. A header line was laid along the top of the trench and 12-ft. lengths of hose were connected by unions to this header line and lowered into each bell-hole where there was water. The method proved satisfactory in keeping the bell-holes dry.

The progress of the work for a week was so arranged that the digging and laying of the pipe ended Saturday noon. All uncompleted joints were then finished Saturday afternoon, or on Sunday if necessary.

To test the line a 48-in. plug was put in the last pipe by means of the traction crane. When the last joint had been calked, the three compressors were hooked up to the line and it was possible to secure 15-lb. pressure in the line inside of 8 hours. The tests were cumulative, the air being placed on each week's work in addition to the line already finished.

The contractor backfilled the trench with a power backfiller and puddled the dirt by means of a fire-hose connection to hydrants at street intersections. Excess dirt, which amounted to ¾ cu.yd. per lineal foot of ditch, was loaded by a clamshell crane on traction wheels, into auto-dump trucks and hauled away from the job to be wasted on vacant property.

The line was completed early in October and on Oct. 15 gas under 1-lb. pressure was turned in to blow out the air. Three hours later analysis indicated all of the air had been displaced and the full 5-lb. pressure was then admitted.

The new main was laid under the direction of John H. Eustace, chief operating engineer, with W. G. Rudd, assistant operating engineer in charge of the engineering details. Supervision and construction were carried on by the department of streets, of which C. L. Day is general superintendent, John Ginley, assistant general superintendent, and F. S. Carnes, superintendent of the south division.

Automatic Train Control Needed

A rear end collision between two freight trains on the Illinois Central R.R. at Hammond, La., was caused by the failure of the engineer of the following train properly to observe and obey automatic block-signal indications. The director of the bureau of safety of the State Commerce Commission comments as follows: "This accident again directs attention to the necessity for an automatic train-control system which will operate and control a train whenever for any cause an engineer fails to see or heed danger signal indications. In accidents of this character involving automatic-block signals, such failure of the human element can not be fully checked and provided against except by the use of an automatic train-control system to supplement existing signal systems for the purpose of compelling obedience to such indications."

From Job and Office

Hints That Cut Cost and Time For the Contractor and the Engineer

Fire Hose Towers Protect Camps Despite Heavy Snowfalls

SEVERAL construction camps on the Big Creek project of the Southern California Edison Co. are located at elevations above 7,000 ft. where snow accumulates to great depths every winter. In the highest camp, at elevation about 9,000 ft. a 20-ft. depth of snow is not unusual. With several hundred men in such camps and important work at stake, adequate fire protection in winter time has been given careful study with the result that instead of being put on the ground in the usual way, fire plugs, together with the necessary hose, have been located in wooden towers whose height varies with the average depth of the winter's snow.

CAMP FIRE PLUG DESIGNED FOR WINTER SERVICE

These towers are located at strategic points throughout the camp and are arranged as shown in the accompanying illustration with the water main leading to the plug incased in earth or sawdust to prevent freezing and a small house on top of the platform in which lengths of hose can be stored.

Macadam Road Smoothed by Combining Dragging With Surface Treatment

BY A. H. HINKLE
Superintendent of Maintenance, Indiana Highway Commission

A NEW method of making smooth a rough macadam surface by the use of surface treatments combined with dragging, has been used with success on one of our state roads. The work in this particular instance consisted in combining the surface treating of an old macadam road with a process of dragging, which resulted in transforming a rough and irregular surface into one much smoother.

About two years ago a waterbound macadam road was built under traffic, a condition which prevents the surface from being smooth when completed. This surface had been treated with tar in 1922 but the irregularities were still prominent. This year it was decided to retreat the surface. The surface was first swept and about .18 gal. per square yard of tar was applied with a bituminous distributor; and a light coat of stone ¾ in. to ½ in. in size spread thereon.

This part of the work was done by the ordinary method for any good surface treatment. The surface was then dragged with a road maintainer which scraped the screenings coated with tar into the depressions in the surface, leaving the road quite smooth. The surface was then given another treatment of tar of about the same amount as used in the first treatment, and another light application of clean screenings was applied. By this double treatment process and the dragging operations a smooth surface was left which ironed out under traffic. The grade of tar used was a medium heavy surface treatment tar with a viscosity of 25 to 40 at 40 deg. C. Dragging should be done not too soon after the first treatment is applied but before the tar has become set. Also, it is desirable to permit little traffic over the road after the dragging and before the second treatment of tar is applied.

While this method has not yet been attempted with asphalt, there is no reason why the same process would not be satisfactory if the right grade of asphalt is used.

Methods for Carrying Precise Levels Over Wide Bodies of Water

QUITE often surveying presents problems upon which there is little published data explaining the "best method" of solution. In river crossings, for instance, it will often be necessary to carry a line of precise levels over an arm of water too wide for ordinary sighting and not spanned by a structure of sufficient stability to carry a line of levels. In his recently-published Department of Commerce bulletin on "Use of Geodetic Control for City Surveys" Hugh C. Mitchell, mathematician of the U. S. Coast and Geodetic Survey, explains two precise methods of carrying levels across such wide bodies of water. Ten such crossings, varying in length from 790 to 4,400 ft., were met with in a survey of New York City.

The first of these is the fixed-target method and the second the movable-target method, and both will produce an accuracy comparable to what is attained in leveling over land. These methods are described by Mr. Mitchell as follows:

Movable-Target Method—On the New York City survey special targets were constructed for each river crossing. These targets had the same general design but differed in absolute dimensions and in some details of design, depending on the width of the crossing. They were clamped onto the regular level rods. The observations were made simultaneously from both sides of the river and required, therefore, two levels which were as nearly alike as possible. The instruments were very carefully adjusted and were set up on opposite sides of the river with the rods held on bench marks or turning points about 20 ft. distant from each. After each observer had read the near rod he then sighted across the river and by prearranged signal waved the target into position at the same time that the observer on the other side of the river was performing the corresponding operation.

In order to permit a change in atmospheric conditions to take place, five minutes were allowed to elapse before the targets were again waved into position for a new set. After

10 such sets had been obtained the observers changed stations, each observer taking his instrument with him, and 10 more sets were observed, followed by readings on the near rods. Such a series of observations will ordinarily give a satisfactory determination of the difference of elevation of the two rod stations. If the result should not have the accuracy desired, the atmospheric conditions should be carefully studied and more sets should be taken at such a time that the observations will be least likely to be subject to any abnormal refraction.

Particular attention should be paid to seeing that the line is not too close to the water, and that observations are not made when the sun is shining brightly in patches on the water through breaks in the clouds. There should be no change in the focus nor any disturbance of the line of collimation of the instruments in exchanging stations.

It is readily seen that the mean of simultaneous observations will be free from the effects of curvature and ordinarily from those of refraction. In practice it is best to combine the 10 readings on each rod in each set by taking a straight mean before subtracting to obtain an approximate difference of elevation. This also enables one to study the actual observations with the view of determining if any of them are beyond the limit of rejection.

A safe rule to follow in rejecting observations is given in "The Adjustment of Observations," by Wright and Hayford, who advise the rejection of each observation for which the residual exceeds five times the probable error of a single observation. Each observation for which the residual exceeds three and one-half times the probable error of a single observation should be examined, and if any of the conditions under which the observation was made were such as to produce any doubt it should be rejected.

The probable error of a single observation is computed from the formula

$$r = 0.6745\sqrt{\frac{\Sigma v^2}{n-1}}$$

in which r is the probable error of a single observation, Σv^2 is the sum of the squares of the residuals from the arithmetic mean, and n is the number of observations. Where an observation is rejected, it should, if possible, be replaced by another observation, in order that the computation may be kept as simple as possible by avoiding the introduction of unequal weights.

After correcting the approximate difference of elevation from the separate sets for index error of rod, rod length, and temperature, the results may be combined into one mean, giving the final difference of elevation of the rod stations. The computations may be made by combining either the means corresponding to simultaneous observations or the means representing a given instrument in its two positions. If the sets of observations are perfectly symmetrical, the final result will be independent of how the combination is made.

Fixed-Target Method—In this method the micrometer screw of the instrument is used to make readings on the rod above and below the level line of the instrument. It is essentially a method of vertical angles into which the absolute values of the vertical angles do not enter. The stations are selected with due regard to water line and height above water surface, and the rods are held in place by guys. Two targets are clamped on each rod in such position that one is above and the other below the point on the rod intersected by the middle wire of the diaphragm when the instrument is level. A single observation consists of three readings of the micrometer, one when the middle wire bisects the upper target, another when the instrument is made level, and the third when middle wire bisects the lower target. The positions of the targets on the rod may be closely measured, using dividers and scale. The point at which the middle wire cuts the rod when the instrument is level may then be easily computed, the intercepts on the rod being in direct proportion to the differences of the micrometer readings.

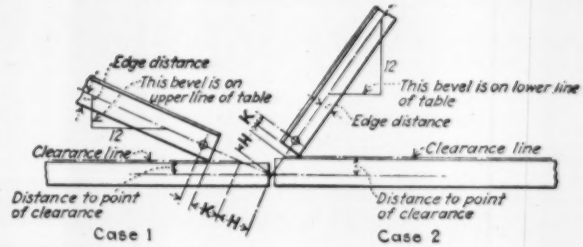
The program of observing adopted by the U. S. Coast and Geodetic Survey in making a crossing over the Mississippi River at a point where the width was 1,200 m. (0.75 mile) was as follows.

Two instruments were used and the observations on the two sides of the river were made simultaneously. The near rod for each instrument was first read and then, on a signal from the observer in charge, observations were begun across the river and continued until the observer in charge had made 25 sets of observations, when, on signal, observing across the river ceased. The observers then changed stations, carrying their instruments with them, using care not to disturb the focus or line of collimation, and the program was repeated, except that the near rods were read last. The observers changed stations again and a third repetition of the program was made. This constituted a day's program and was repeated on at least one other day.

The reduction of observations made by this method do not differ materially from the computation where the movable-target method is used.

Table for Locating First Rivet of a Gusset Connection

A CONVENIENTLY arranged table for finding the distance from the center of a gusset-plate connection to the first rivet of a connected member is given by L. S. Owen, of Nashville, Tenn. The arrangement of the table may be understood from the sketch herewith,



Bevel Upper is Flatter Slope	To Find H: Distance from Axis to Point of Clearance											To Find K: Edge or Angle etc.											
	⅛	¼	⅜	½	⅝	¾	⅞	1	2	11	1-0	1½	2	2½	3	3½	4	4½	5	5½	6	6½
1	1⅛	3	4⅞	6	7⅛	9	10⅞	1-0⅛	2-0⅛			1-1⅛	1-4½	1-9	2-0	2-6							
	⅛	¼	⅜	½	⅝	¾	⅞	1	2	11	1-0⅛	⅛	⅛	⅛	⅛	⅛							
1¼	1⅜	2⅝	3⅞	4⅞	6⅛	7⅛	8⅜	9⅜	1-1⅜			10⅜	1-1⅛	1-4½	1-7⅝	2-0							
	⅛	¼	⅜	½	⅝	¾	⅞	1	2	11⅜	1-0⅜	⅛	⅛	⅛	⅛	⅛							
1½	1	2	3	4	5⅛	6⅛	7⅛	8⅛	1-4⅛			9	11	1-2	1-4	1-8							
	⅛	¼	⅜	½	⅝	¾	⅞	1	2	11⅛	1-0⅛	⅛	⅛	⅛	⅛	⅛							

TABLE FOR LOCATING CONNECTION RIVETS

in which for any given bevel of connected member the required rivet distance is found by reading from the table separately the items H and K, the first depending on the clearance width of the main member and the second depending on the edge distance of the rivet in the connected member. The table contains a double line of figures for each bevel, beginning with 1 in. in 12. The left-hand portion of the table, of which only a part is shown, gives the quantity H, the right-hand portion the quantity K. Values of H are given for various clearance widths from ⅛ in. to 1 in. by eighths, and from 1 to 12 in. by inches. The right-hand part of the table gives the values K for various edge distances of the connected member from 1⅛ to 2½ in., multiples of these values being read from the table by mentally multiplying the value K. The required rivet distance is the sum of H, K, and the end distance of the rivet.

The double line of the table for each bevel represents separately case 1 and case 2 of the sketch, the upper line being for case 1, members of flat slope, and the lower line for case 2, members of steep slope. The complete table for all bevels from 1 in. to 12 in. may be calculated by the use of existing tables, and inserted in a handbook for use in detailing or checking drawings.

Narrow-Gage Tracks Used in Moving Houses to New Location

By E. G. McGill
Contractor, Cumberland, Maryland

THE Sewerage Commission of Hagerstown, Md., desiring to get an outlet for the sewer and build a boulevard at the same time 100 ft. wide, has just completed moving eight six-room frame houses and one 12-room double brick and stucco house, a distance of one-third of a mile. The frame houses were moved on double lines of 3-ft.-gage track with 56-lb. rails.

The ground was in celery ridges, but by using a four-horse road grader a good level roadbed was obtained and narrow-gage ties were used in laying the tracks. Four pony trucks of four wheels each were coupled together from track to track by a 5x10 timber with a truss rod support. Then a 14x14 timber, 44 ft. long, resting directly over the king bolts, coupled up each set to suit the length of the building to be hauled, with needles 12 in. x 12 in. x 36 ft. every 6 ft. crossing them as carrying timbers.

The houses all had full cellars, 6½ ft. deep, and by grading down and removing foundation walls the hauling frame was backed in under as far as possible. The fact that the buildings were all in a row and built up close together, high from the ground, made it easy to get in under them. Coming up crosswise to them it was necessary to turn each building one-quarter turn to set it on the platform. This turning was done on 4-in. rollers. In order to square each house with its new lot, and because a sharp curve had to be used in approaching new locations, tracks were laid on past the location and then thrown over the new site by crowbars.

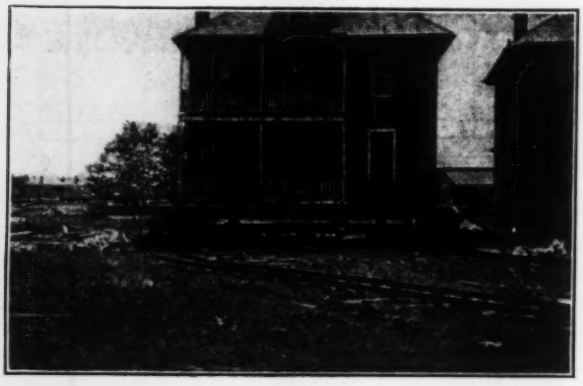


FIG. 1—NARROW-GAGE TRACK USED IN MOVING HOUSES

When a house had to be turned around, a "Y" was employed.

The double brick house was not loaded on this railroad track but was rolled on six nests of alternating iron and wood rollers, ten to a nest.

A steel I-beam, 6x20 in. and 40 ft. long, was placed under each end wall of the building, and three pieces of 12x12 timber were placed up under the joist. Then 12x12's, 36 ft. long, and steel I-beams, 5½x15 in., 36 ft. long, were placed on 4-ft. centers as cross-needles.

The track was filled level with the surface of the rail with 4-in. crossing plank, with a third rail laid in the center, making a complete track of 3-ft. gage. Turning some very short curves, by cutting rollers to suit, the house was successfully moved. The time for truck moving was 10 ft. to the minute, and for the rollers 2½ ft. to the minute.

From Job and Office

Hints that Cut Cost and Time

FIG. 2—250-TON BRICK HOUSE MOVED ON ROLLERS LAID ON NARROW-GAGE TRACK

The frame houses weighed about 100 tons each, and the brick house about 250 tons. These houses were moved to their new locations through a peat marsh, much water being encountered at places.

This work at Hagerstown, Md., was contracted for by the writer.

Los Angeles Hotel Moved to New Site

IN ORDER to make room for the new Los Angeles County Hall of Justice, the 6-story reinforced-concrete Alhambra Hotel has been moved 122 ft. and set on a new foundation. The method of moving is similar to that used in moving a Chicago warehouse, described in *Engineering News-Record*, April 26, p. 754.

The hotel was moved on 19 tracks, the structure being supported and tied together by steel girders running transversely and steel needles extending longitudinally. Each track consisted of four 60-lb. steel railroad rails laid on 6 x 6-in. wood ties resting on four 12 x 12-in. wood sleepers. Each girder was made up of three 15-in. steel I-beams bolted together; and there is one over each track resting on 2½-in. solid steel rollers which travel over the rails.

Two steel cables were used to pull the structure, one 2,500 ft. and the other 1,600 ft. in length. These cables are ⅝ in. in diameter, of plow steel, consisting of 6 strands of 19 wires each, and having a tensile strength of 32,000 lb. The cables run through two lines of sheaves, one set being fastened to 12 x 12-in. timbers set against the ends of the steel girders on the south side of the structure and the other set being fastened to iron stakes driven ahead of the tracks. There are 45 of these sheaves and the cables run back and forth from one line to the other like the lace in a shoe. Moving the structure was accomplished by teams operating the capstans.

From Job and Office

For Contractor and Engineer

Crane Excavates and Builds Cofferdam for Filtered Water Basin

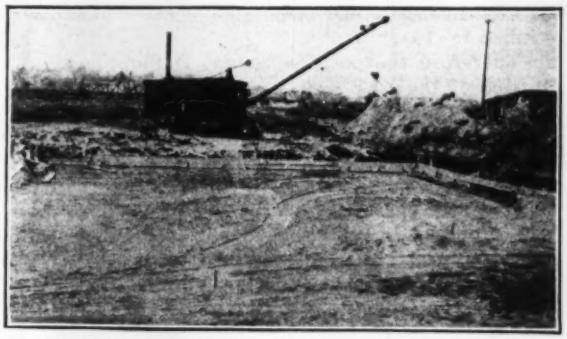
EXCAVATION for the cofferdam for the filtration and coagulating basins at Benton Harbor, Mich., was carried out by the use of a crane and by sluicing, after the top layer of earth and clay had been stripped. The stripping of this top layer was started by hand, the material being hauled by teams to spoil banks; later teams and slip scrapers were used to hasten the work.

The material encountered below the top clay layer is a fine water-bearing sand which when dry is very compact but when wet is almost liquid. In places where the ground water was near the surface, it was removed by the use of a 6-in. steam-engine-driven centrifugal pump, indicated in the diagram as Pump 1.

The crane was then used for driving the wakefield sheeting, bracing and anchor piles and for excavating. A 2,800-lb. steam hammer was rigged on the 30-ft. boom of the crane and a 2½-in. jet line was used to help sink the sheeting through the sand. The details of the cofferdam are shown on the sketch. The sheeting was from 14 to 16 ft. high and was driven from 6 to 8 ft. below the foundation of the basin.

For excavating after the sheeting was driven, a ¾-yd. clamshell bucket was rigged on the crane, and excavation was made to an average depth of 5 ft.

The work of the crane is shown in the diagram, starting at position 1 in the northeast corner and driving the round piles along the east side, then moving to

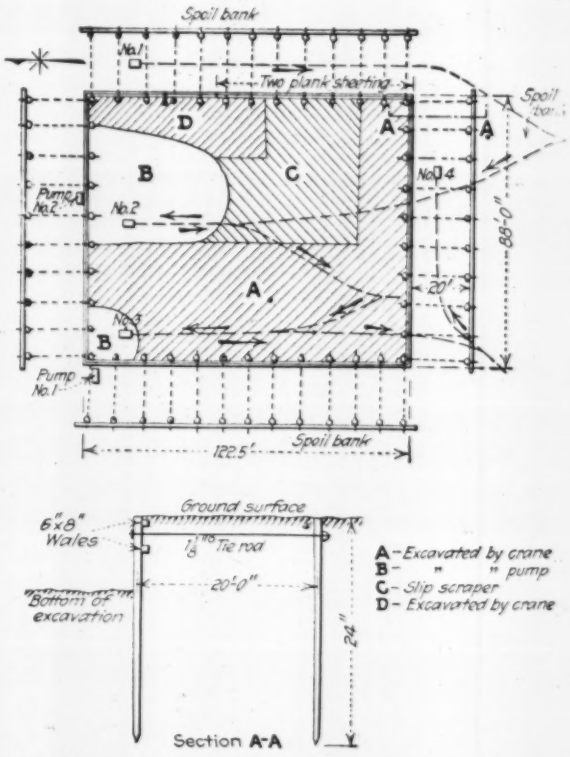


CRANE HAS 28,000-LB. HAMMER AND 30-FT. BOOM

positions 2 and 3 and driving the round piles and sheeting along the north side and excavating to grade. The final location of the crane was position 4 for excavation and driving on the south side, the west side driving and the excavation in section A having already been finished.

Sluicing was done in the two sections designated on the diagram as B. By the use of pump 1 and an additional pump 2, the excavated material was sluiced over the site for the coagulating basin; the sand was stirred up and held in suspension by means of a 2½-in. jet line.

Location C could not be reached by either the pumps



DETAILS OF COFFERDAM OF FILTRATION AND COAGULATING BASINS AT BENTON HARBOR

Positions of the crane from which excavation and driving of the piles were done are numbered. Other methods of excavation are also indicated.

or the crane. So a slip scraper was rigged with a rope over the niggerhead of the crane and the material in C was pulled over to the south end of the cofferdam where the bucket could reach it.

When all the excavation had been made to approximate grade, drainage was accomplished by ditches along the sides of the cofferdam leading to a sump constructed in the northwest corner of the cofferdam. All mud holes were cleared and filled with clean material. Also, clean material excavated from the cofferdam was piled near by for use in backfilling.

When the concrete was poured, care was taken to keep the bottom of the cofferdam compact and solid, which was accomplished by the use of the pumps to keep the water level down. The finish grading was done by hand.

This work was carried out under the general supervision of Pearse, Greeley & Hansen, consulting engineers, Chicago.

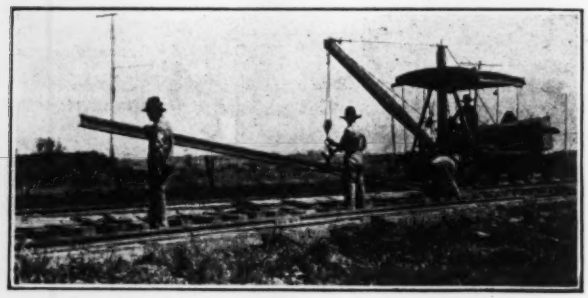
Concrete Mixer with 50-ft. Boom

IN PAVING a new concrete highway near London, England, having a width of 50 ft. between curbs, the mixer moved outside of one curb line and the concrete was placed by a bucket traveling on a steel truss or boom which spanned the entire width of road. One end of the truss was carried by the traveling mixer outfit and the other end by a steel frame or tower. The bucket was of the tilting type, carried in trunnion bearings on hangers attached to a trolley running on the bottom chord of the truss and operated by a cable and drum.

Renewing Rails with Small Power Crane

A LIGHT self-propelling power crane which not only reduces the labor force required in renewing rails but increases the amount of work done has been designed and used extensively on the Atchison, Topeka & Santa Fe Ry. This machine, shown in the accompanying view, consists of a small flat car equipped with a timber mast and boom and a gasoline engine. A similar car may be attached as a trailer to carry a tool box. Only four men are required, even with heavy rails: one operates the hoist, another handles the rail tongs attached to the fall rope, and the others (one at each end) guide the rail into place.

This crew has laid as many as a hundred rails in an hour, according to W. F. Muff, roadmaster, Newton, Kan. And with the use of the machine a gang of a hundred men can be kept busy spiking, gaging and bolting up the new rails. On busy main track, 300



RAIL-LAYING CRANE: A., T. & S. F. RY.

rails have been laid in the morning, while the afternoon was then occupied in full spiking and bolting the track and disconnecting the old rails.

The machine was designed jointly by the late J. Raymond, formerly general superintendent of the A., T. & S. F. Ry., and J. F. McNally, now assistant superintendent at Emporia, Kan.

Fourth Scale for Log Log Slide Rule

BY C. S. JARVIS
Consulting Engineer, Salt Lake City, Utah

AMONG the special types of slide rule that have been developed from the original simple form, it is probable that the log log duplex slide rule has the widest range of application, as it combines the essential features of most of the other forms, and has the special advantage in the solution of exponential formulas. If the various formulas involved in the study of interest, annuities, and amortization are involved in such computations, it will be noted that a large percentage of the problems will require the use of factors from 1.0025 to 1.01, representing the amount of principal and monthly interest, where the rate per annum is from 3 per cent to 12 per cent.

Due to the rapid decrease in the values of the log log scale below 1.01 compared with the corresponding decrease in the series of numbers from which this scale is derived, the makers of slide rules have advised the use of suitable factors to render any number appearing between this limit and its reciprocal, 0.990, into a convenient form for use on the scales already provided. This necessitates the use of the same factor as a divisor, affected by the various exponents or root indices, thus

From Job and Office

Hints that Cut Cost and Time

requiring additional settings of the slide and increasing the labor involved and the chance for errors.

The writer had occasion to solve such problems, and found it worth while to provide an additional scale, which for convenience is called LL0, covering all values from the number 1.00105 to 1.01, or from the thousandth to the hundredth root of e, the base of Napierian logarithms.

The location of the graduations on the LL0 scale will be referred to the LL1 scale, and values given corresponding to various rates of interest per annum reduced to the monthly basis.

Interest per Annum, Per Cent	Interest per Month, Per Cent	Reading on LL0 Scale	Reading on LL1 Scale
1.26	0.105	1.00105	1.01
2	0.1666	1.0016667	1.01679
3	0.25	1.0025	1.0253
4	0.3333	1.003333	1.0338
5	0.41667	1.0041667	1.04245
6	0.5	1.005	1.05115
7	0.58333	1.0058333	1.0599
8	0.66667	1.0066667	1.0687
10	0.8333	1.008333	1.0865

While the above tabulation includes all of the most commonly used factors for computing interest compounded monthly, any intermediate value not provided for on either of the LL scales can be readily computed when account is taken of the relation existing between contiguous LL scales, the upper one being the tenth root of the lower. As an example, let it be required to locate the position on the LL0 scale of 1.0045833, principal and monthly interest corresponding to 5.5 per cent per annum.

Log 1.0045833 = 0.0019860.

Log 1.0468 = 0.019860 (the above logarithm multiplied by 10).

Therefore the position sought is immediately above 1.0468 of the LL1 scale.

Approximately this same value would be obtained by interpolation between adjacent graduations, but for best results it appears important that the entire LL0 scale should be added.

It will be observed that the above list of readings for the proposed LL0 scale shows a tendency of the numbers to the right of the decimal point to approach in value those immediately below on the LL1 scale, but the location is one space farther to the right. Thus the tenth root of 1.01 is 0.00105; of 1.03 is 1.003; and of 1.001 is 1.0001 to the nearest practicable reading, either from seven-place logarithmic tables or on portable slide rules. Therefore, if the LL0 scale is provided as above suggested, then the whole field will be effectually covered between 1.01 and 1.0001 for exponential formula computations involving factors within those limits.

As one of the most elementary illustrations of the use of the LL0 scale, let it be suggested to find the time required for an investment to double itself at interest compounded monthly, rate one-third of one cent per month, nearly comparable with 4 per cent per year.

Here the formula becomes $(1.003333)^n = 2$.

Taking logarithms of each side, n log 1.003333 = log 2.

From Job and Office

For Contractor and Engineer

Solving for n; $n = \frac{\log 2}{\log (1.003333)}$

Log n = log log 2 — log log 1.003333.

Placing the left index of the slide under 1.003333 of LL0, read 208.3 on *C* scale under 2.00 of LL2; 208.3 months = 17.36 years.

Following is the solution by logarithmic tables:

log 2 = 0.3010300	log 1.003333 = 0.0014451
log log 2 = 9.4786098	log log 1.003333 = 7.1598979
Subtracting,	7.1598979
log 208.311 = 2.3187119	

The specific reason assigned by instrument manufacturers for not continuing the graduations below 1.01 on the log log scales, the steep slope of the log log curve which passes through minus infinity at abscissa = 1, is a favorable factor in computations involving the LL0 scale, as it effectively magnifies the graduations and conduces to accuracy.

Accounting for Highway Equipment

IN STATE road maintenance, accountability for the wide variety and great number of tools and equipment used has always presented serious difficulties. Because roads upon which equipment is used are so widely scattered, keeping track of tools is not always an easy matter. In a recent issue of the official organ of the Kentucky State Highway Commission, R. F. Albert, assistant engineer of maintenance, explains how that state takes care of its road equipment. The article as abstracted is given in the following paragraphs:

For the purpose of administration and field supervision the state is divided into six districts; at the headquarters of each is the district office, where equipment records are kept. In turn, each district is subdivided with a superintendent of maintenance in charge of each sub-district.

M-133 DUPLICATE

Commonwealth of Kentucky
DEPARTMENT OF STATE ROADS AND HIGHWAYS
Patrolman's Equipment Report

Sheet.....of.....

To District Superintendent:
Following is the equipment in use on Road.....
Sec.....Dist.....Sub-Dist.....
For month ending....., 192..

Article No.			REMARKS
Axes			
Bars, crow			
Bars, pinch			
Brooms			
Drills, churn			
Tractors			
Rollers			
Autos, state owned			

Patrolman
Foreman

M-132 DUPLICATE

Commonwealth of Kentucky
DEPARTMENT OF STATE ROADS AND HIGHWAYS
Superintendent's Equipment Report

District.....Sheet.....of.....
Subdistrict.....Month Ending....., 192..

Articles No.			Remarks
Road No.			
Section			
Axes			
Bars, crow			
Bars, pinch			
Drills			
Drags			
Total			

Approved:.....Submitted.....
Dist. Engr. Dist. Supt.

That superintendent keeps all records pertaining to the various articles of equipment assigned for use on the roads in his sub-district and in storage at his headquarters. In order to account properly for the equipment both in use and storage three forms are used.

First, the patrolman's, foreman's or resident superintendent's form, shown herewith, carries at the end of each month a list of equipment actually in use on that project. This form is forwarded to the superintendent of maintenance, who checks up the report against the previous monthly report and data he has relating to the assignment or release of any equipment.

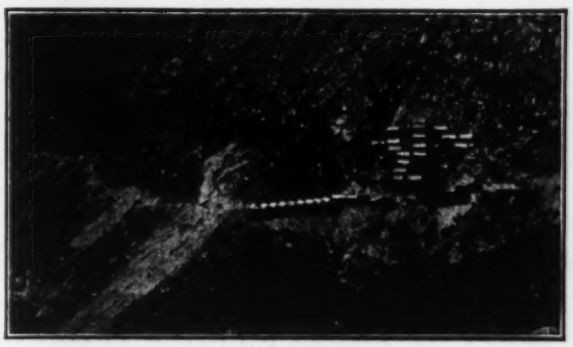
The second form is that compiled by the district superintendent from data contained in all reports from the patrolmen, foremen and resident superintendents. After such data are compiled, the equipment in storage in the sub-district is listed immediately following. Upon the receipt of this form at district headquarters, it is checked with the information contained in the previous monthly report on assignment or release of equipment. A copy of each sub-district report is retained in the district office, the originals being forwarded to the equipment engineer at the central office.

The third is compiled from the information contained in the superintendent's equipment report. This is filed in the district office and in the central office for each district. The form is designed to show the balance on hand of each article of equipment at the beginning of the month, the number of articles both assigned to and released from each district.

With the use of these forms it is possible to know at all times the number of articles of any kind of equipment in a district, its location according to project, and the amount and kind of equipment not in use. It saves time and expense in locating equipment, prevents loss through neglect and unnecessary expenditure for new material.

Construction Camp Built on Canyon Walls

IN DRIVING No. 3 tunnel which parallels the San Joaquin River for several miles, the Southern California Edison Co. found it necessary to establish several



ARRANGEMENT OF STRUCTURES AT BIG CREEK CAMP

adit camps, some of which are located upon precipitous walls of the canyon where level space could be obtained only by excavating benches. The accompanying illustration shows the arrangement of compressor house, mess hall and bunk houses at Camp 35.

The adit enters the canyon wall in a narrow draw or ravine and by excavating at the adit entrance, sufficient space was provided for the main buildings. The bunkhouses, however, could not be located in this limited space and accordingly were distributed as shown in the illustration. Some were made readily accessible by building them on timber trestle work alongside the road built for construction purposes through the canyon. Others, set on the steep hillside above, were made accessible by means of ladders or cleated ramps.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Determining Water Power Storage

Sir—Dr. George E. Lyon's article in your August 9 issue, p. 235, on "Determining Regulated-Flow Duration Curves Graphically," describes an admirable method for working out water power problems involving storage. The most efficient storage capacity for a given site is readily determined by its means.

The writer, having made repeated use of this method, wishes to submit the following additional suggestions with a view to simplifying the numerical work and adding to the utility of the methods. Instead of billions of cubic feet, the day-second-foot will be found the more convenient unit for this work. A day-second-foot may be defined as the quantity of water corresponding to one cubic foot per second flowing for a period of one day of 24 hours. It is, therefore, at once a rate of flow as well as a unit of volume. Its value will be apparent from the following.

In Table I, page 235, instead of writing down the mean monthly flow in second-feet as shown in the third column, head this column "monthly discharge in day-second-feet," and enter in it the total day-second-feet for each month, obtained by adding the daily discharges in second-feet for each month. These figures are nearly always available, being a step in the computation of the mean monthly flow figures used by Dr. Lyon. In fact, tabulated data of stream-flow such as are supplied on request by the U. S. Geological Survey always contain these monthly totals, except when the data are clipped from some publication. (In the latter case it would, of course, be necessary to multiply the mean monthly flow by the number of days in the month in order to obtain the total day-second-feet.) Next, obtain the last column of Table I by merely adding progressively the day-second-foot figures appearing in the preceding column, using an adding machine equipped to give sub-totals. This will save much time and effort over Dr. Lyon's method. Head this last column "accumulated discharge in day-second-feet."

The diagrams are then platted as before, except that the ordinates in Fig. 2, page 236, will be day-second-feet instead of billions of cubic feet, and the abscissas will be days instead of inches. Besides simplifying the numerical work, the principal advantage resulting from the use of the day-second-foot will be found to lie in its dual capacity above referred to. Thus, in the diagram (Fig. 2) it functions either as a rate of flow, or as a quantity of storage, depending upon which is desired. In the latter capacity it affords a quick conversion into acre-feet, as one day-second-foot is equivalent to 1.983 acre-feet, or for all practical purposes 2 acre-feet. Therefore, the ordinates of a diagram like Fig 2, when platted in day-second-feet can also be made to read acre-feet by multiplying the day-second-feet by two, the error so involved being less than 1 per cent, which is negligible in most studies of this kind.

The writer has been in the habit of platting across Fig. 2 a curve showing the state of depletion of the reservoir from day to day, and it will be seen from what has been said above that the acre-foot ordinates are most convenient for this purpose. Where evaporation is large and has to be taken into account, an evaporation curve can be platted likewise across the diagram, its ordinates being derived by computation from the state of reservoir depletion curve, and the evaporation in acre-feet applied as a correction to the latter.

In conclusion, the writer would suggest the use of the term "summation hydrograph" in lieu of "mass curve." The latter name was derived from earthwork computations in balancing railroad cuts and fills. It is a misnomer when applied to hydraulic computations. About 14 years ago the writer started the use of the term "summation hydrograph" as being the most appropriate name for a mass diagram such as is referred to in Dr. Lyon's article, and he has been gratified to note its adoption by many leading men in the profession.

Chattanooga, Tenn., Aug. 11, 1923. GERARD H. MATTHES, Consulting Engineer.

A Passion for Straight Lines

Sir—The editorial, "A Passion for Straight Lines," in the Aug. 2nd issue of *Engineering News-Record*, brings to mind the following exposition in Balzac's "Seraphita":

"Your geometry establishes the fact that the straight line is the shortest distance between two points, but your astronomy shows you that God proceeds only in curves. Who can judge then between rectilinear and curvilinear geometry? Between the theory of the straight line and the theory of the curve? The bullet which a man would shoot straight really goes in a curve. None of your savants has drawn the simple deduction that the curve is the law of the material world, but the straight line is the law of the spiritual world. Does not the love of great souls for the straight line show in them an intuition of heaven?"

This last sentence may console some engineers who, like Mr. Friedman, have been accused of sacrificing beauty to an engineering passion for straight line. They may further fortify themselves by reading the introduction to Miss Wormley's English version of "Seraphita" where the occult doctrines of the circle as the perfect figure and the effect of the curve on the development of architecture are gone into at some length, and where it is explained that Balzac has departed from his Swedenborg in this instance and has considered the circle as symbolic of the created or the Material, which perhaps appears more beautiful to us on an earthly plane than the straight line, though this represents the uncreated or the Infinite.

RUTH CANAVAN, Librarian with Metcalf & Eddy.

Boston, Mass., Aug. 10.

A Curious Judicial Decision

Sir—I have read the review of the decision of the Pennsylvania Court of Quarter Sessions, declaring the Pennsylvania engineers licensing law unconstitutional, in your issue of Aug. 2, 1923. I could not but feel a considerable amount of self-contained amusement after studying the report of the decision. It brought me back to the days of my childhood, when we had to parse sentences. What struck me in reading over the resumé was the objection to the law on the ground that it was unconstitutional for the reason that it contained "more than one subject." As I said before, this brings me back to the days of my study of sentence formation and construction.

Is the subject of the bill in all fairness, and sensible interpretation, "an act to regulate the practice of professions," or is it an act to regulate the practice of engineering and land surveying? According to the judge's interpretation, if Pennsylvania is going to regulate the practice of the professions of lawyers, mechanical engineers, surveyors, civil engineers, "advertising engineers," electrical engineers, plumbing engineers, sanitary engineers, *ad infinitum*, I suppose that a special act would have to be passed for each of the particular kinds of engineers or occupations.

After all, does the foregoing not strike you as somewhat absurd especially when the regulation for all of the different kinds of persons in the several occupations might be a single regulation applicable to each. I predict that if there is any appeal from the decision there is a high probability of reversal on the ground I mentioned.

Cleveland, Ohio, Aug. 14, 1923. J. F. ROBB, Attorney at Law.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

News Brevities

A Public Hearing on the Advisability of building a bridge across the Hudson River at New York City, will be held at the Army Building in New York on Monday, Aug. 27. The North River Bridge Co., of which Gustav Lindenthal is the head, has asked the War Department to approve the plans submitted by that company.

Abandonment of 122 Miles of the Hartford & Connecticut Western R.R., a subsidiary of the Central New England R.R., has been proposed by C. M. Sheafe, president of the H. & C. W. The reason given for the proposal is that the greater portion of the railroad is unnecessary and unprofitable. No action can be taken until the Interstate Commerce Commission has approved of the abandonment.

Premier Massey Has Formally Opened the new Otira tunnel at Arthur's Pass, on South Island, New Zealand. The tunnel links the east and west coast of the island and replaces the dangerous coach route which formerly connected the two electrical coastal railways of that island. The tunnel is 5¼ miles long and has a maximum gradient of 3 per cent. It is ¼ mile longer than the Connaught tunnel in the Canadian Rockies, the longest tunnel on the American Continent.

Proposing to Build a Bridge Across the Niagara River at Fort Erie for vehicular and electric railway traffic, the Buffalo-Ft. Erie Public Bridge Co., Ltd., has received both Canadian and American charters and has now applied to the U. S. War Department and to the Dominion Department of Public Works for authority to bridge the Niagara River at that point. The proposed bridge will supersede the present ferry service and will cost between $3,000,000 and $4,000,000. The officers of the new bridge company are as follows: W. M. German, M. P. of Welland, president; Dr. William Douglas, Fort Erie, and Donald McGillivray, Port Colborne, vice-presidents; F. W. Wilson, Fort Erie, secretary-treasurer.

To Demonstrate the Ability of the army engineers and to reproduce various kinds of maps quickly during field operations, the Army Engineer Corps is sending its mobile map-making train to important points in the country. The train consists of a completely equipped laboratory mounted on army trucks, with facilities for making maps or reproducing them by photography, printing and lithographic processes. The train is manned by men of the 26th Engineers, the same unit that did such efficient map work in France. The train has just returned from Rio de Janeiro, where it was part of the American exhibit at the Brazilian Centennial Exhibition.

Denies Reported Electrification of Boston & Albany

The report that the New York Central plans to electrify the Boston and Albany and its new yards near Albany in the immediate future is not confirmed by G. W. Kittredge, the chief engineer. Mr. Kittredge says that the engineering department prepared a report on such electrification more than a year ago as a routine matter and that as far as he knows nothing more has been done about it.

Court Upsets Hoboken Garbage Contract Award

As a result of a suit brought by a lower bidder the New Jersey Supreme Court has set aside the award by the City Commission of Hoboken on July 31 of a five-year contract for the collection and disposal of garbage and ashes. The award was made to James J. McFeeley, a brother of Bernard McFeeley, the latter being a member of the City Commission and director of the Department of Public Safety. The accepted bid was for $486,260. The lower bid of $476,580, by Peter A. Peluso, the present contractor for the work, was passed over on the ground that Mr. Peluso gave unsatisfactory service last winter.

U. S. Navy Starts Scrapping Ships

With the receipt last week in Washington of France's formal acceptance of the naval disarmament treaty, all of the other signatory powers having previously signed, plans were immediately put into effect by the United States Navy to scrap ships condemned under the terms of the five-power treaty. Of the condemned ships eleven are under construction, seven of which are battleships located as follows: the "Indiana" and the "South Dakota" in New York; the "Montana" at Mare Island; the "North Carolina" at Norfolk; the "Michigan" at Quincy; the "Iowa" at Newport News; and the "Washington" at Camden. The battle cruisers, "Lexington" and "Saratoga" are being converted into airplane carriers. The other four battle cruisers, two of which, the "Constitution," and the "United States," are under construction at the Philadelphia Navy Yard, and two, the "Constellation" and the "Ranger," are under construction at Newport News, will be scrapped at once.

In addition to these vessels under construction, the following already completed will be scrapped "Virginia," "New Jersey," "Rhode Island," "Georgia," "Nebraska," "Connecticut," "Louisiana," "Kansas," "Vermont," "Minnesota," "South Carolina," "Michigan," and "New Hampshire."

The Navy Department has adopted three methods in disposing of the ships which methods cover in brief the three situations with which it is confronted: disposal of ships being constructed privately, those being built by the U. S., and those completed.

Grunsky Is Nominated as Am. Soc. C. E. President

Second Ballot Gives Him 162 More Votes Than Francis Lee Stuart—Other Official Nominees

C. E. Grunsky, with 1,671 votes as against 1,509 for Francis Lee Stuart, has been selected as the official nominee for president of the American Society of Civil Engineers. A total vote of 3,203 was canvassed, the tellers reporting results of the second ballot to the secretary of the society, August 15, in accordance with constitutional provisions. An aggregate of 3,395 votes was registered but 189 voted who were ineligible, one affiliate, and three signatures were illegible. The other official nominees are:

For vice-president, Zone 1, Lincoln Bush; vice-president, Zone 4, Oscar S. Bowen; directors, District 1, Thaddeus Merriman and Paul G. Brown (two to be elected in this district); director, District 4, Robert Farnham; director, District 11, Arthur O. Ridgway; director District 14, Alexander Maitland, Jr.; and director, District 15, J. M. Howe.

The complete vote follows:

For President:	
Carl E. Grunsky	1,671
Francis Lee Stuart	1,509
Void	11
Blank	12
Total	3,203
For Vice-President, Zone 1:	
Lincoln Bush	845
Void	6
Blank	37
Total	888
For Vice-President, Zone 4:	
George G. Anderson	399
Oscar S. Bowen	520
Void	3
Blank	9
Total	931
For Directors, District 1: (2 to be selected)	
Paul G. Brown	455
Thaddeus Merriman	513
Void	4
Blank	34
Total votes cast	1,006
For Director, District 4:	
G. H. Blakeley	20
Robert Farnham	98
John Meigs	89
Void	1
Blank	2
Total	210
For Director, District 11:	
Arthur O. Ridgway	231
Blank	18
Total	249
For Director, District 14:	
E. A. Hadley	43
Alexander Maitland, Jr.	124
G. F. Maitland	11
Void	1
Blank	2
Total	181
For Director, District 15:	
J. M. Howe	140
J. H. Brillhart	60
Void	2
Total	202

W. F. Reeves is chairman of the Nominating Committee. The elections are to be announced at the annual meeting next January.

Secretary Work Explains Davis Removal

Answering Am. Soc. C. E., He Says Time Has Now Come for Business Administration

Secretary of the Interior Work has addressed the following letter to Secretary John H. Dunlap, of the American Society of Civil Engineers, in response to the request of that society for information regarding the recent removal of Arthur P. Davis from the position of director of the U. S. Reclamation Service:

"Your courteous inquiry of June 27, reply to which has been delayed because of my absence from the States, requires more than a categorical answer.

"The reclamation law, providing for the construction and operation of irrigation projects, mentions no official, but places the entire burden and responsibility of administering the law and of carrying out its purposes upon the Secretary of the Interior.

RESPONSIBILITY ON SECRETARY

"It creates no position known as Director or Commissioner of the Reclamation Service, nor any other position, but places the whole responsibility for selection of agencies for the performance of his work on the Secretary of the Interior.

"In the beginning, necessarily, the work was the construction of projects involving engineering skill, but with their completion there grew up another aspect, namely, the problem of the water-users and the collection of the original cost as contemplated by the law. It is thought that these problems, which involve dealing with the farmers individually, could be best handled by a practical business man familiar with the conditions peculiar to irrigation in the West.

"The return of the enormous investment made by the Government will necessitate help and advice to the farmers on the projects, along the line of subdivision of large land holdings, getting more settlers on the projects, securing creameries, sugar factories and other industrial enterprises; more intensive farming, diversification of crops and co-operation with the owners and tenants on 53,000 farms as to packing, handling and marketing their products by men who have been trained along these lines.

"This does not mean a diminished construction program, but rather an increased and accelerated construction, because with the money returned to the Government under efficient business management there will be freed a fund to continue construction that would otherwise be retarded.

"To handle the engineering work the engineering force of the service remains efficient, with the same chief engineer at its head who has been engaged in the construction work for many years. There is no thought of minimizing the importance of reclamation engineering. It was my purpose to retain Director A. P. Davis in the Reclamation Service as a consulting engineer, he at first consenting but subsequently declining the appointment.

"The Secretary of the Interior, who alone is charged with the execution of the Reclamation Act, desires the greatest possible efficiency—not alone efficiency in one phase of the work, but efficiency in every phase and aspect of reclamation. He believes that the change to which you refer is made necessary by existing conditions; for unless improvement can be brought about many projects will be abandoned entirely by settlers—some have already gone—and the Government not only will lose millions of dollars invested, but the settlers themselves will lose time, labor and money already placed by them on their farms.

"Although it is primarily essential to construct dams and ditches, these are not alone enough to secure successful farming to settlers, for whom reclamation was instituted.

"All of our reclamation projects are not prosperous. It is not a question now of engineering so much as it is one of business acumen and operation. The men on the project must reimburse the Government for its millions of dollars advanced for the reclamation of land through irrigation, and our reorganization with this in mind seemed necessary.

"Because of the publicity I am advised this matter has obtained, I am taking the liberty of giving my letter to you to the press. that it may answer other similar inquiries."

Moffat Tunnel Bids to Be Received Sept. 12

Bids for the construction of the Moffat tunnel through the Colorado Rockies, will be received Sept. 12, and not Sept. 16, as previously announced. Bids were originally to have been opened Aug. 25.

Grounds and Building Committee for Philadelphia Fair

The Grounds and Building Committee for the Sesquicentennial Fair in Philadelphia in 1926 has been announced by Ernest T. Trigg, chairman of the Fair Executive Committee. On the committee, which already numbers fifty-eight, are many engineers, architects and other notable Philadelphians. The chairman of the committee is Howard B. French, a former president of the Philadelphia Chamber of Commerce, and the vice-chairman is William F. James, ex-president, Engineers' Club of Philadelphia. On the executive committee, besides the two just named, are E. B. Temple, assistant chief engineer, Pennsylvania R.R., and George S. Webster, of the Delaware River Bridge Joint Commission.

White River Power Project

A hydro-electric development to produce 160,000 primary electrical horsepower on the White River in the heart of the Ozark Mountains is proposed by the North American Co. The proposed development includes the construction of a dam 225 ft. high and 1,800 ft. long at the crest, which will form a lake nearly 100 miles long to cover an area of 150,000 acres. The Dixie Power Co., which is authorized by the State of Arkansas to construct water power projects on the White River, has received a preliminary permit from the Federal Water Power Commission, and has given Hugh L. Cooper & Co. an option on all its rights and holdings.

Interior Department Tells New Reclamation Policy

Press Memorandum of Aug. 17 Calls for Greatest Efficiency From Officials Concerned

On Aug. 17 the Department of the Interior issued the following "Memorandum to the Press." This memorandum, and the foregoing letter from Dr. Work to the American Society of Civil Engineers, are commented on in the editorial pages of this issue:

"Inculcation of business principles into the operation of existing reclamation projects and in the construction of new projects is contained in a tentative policy adopted by the Reclamation Bureau of the Department of the Interior for the future.

"Made public today by Secretary of the Interior Work this tentative policy calls upon all project managers and engineers of the Bureau to bring about the greatest possible efficiency both in assisting the farmers in selecting, raising, and marketing of their crops and in reducing the cost of building new irrigation works. An outline of proposed policy follows:

"*Existing Projects*—Reduce overhead costs; deal with projects and water users as an engineering and business problem; encourage subdivision of large holdings into small farms, when better farming will follow; encourage and assist farmers to diversify and rotate their crops; aid in securing creameries, sugar factories, and other industries within or near the project limits to the end that a ready and profitable market for the products of the farm may at all times exist and be available; co-operate with the farmers in the packing, handling, shipping, and marketing of their products to the end always, that the maximum of return with the minimum of expense may come to the farmers; and impress on water users the idea that the Government money advanced for the construction of these projects was temporarily for their benefit in the nature of a loan without interest.

"*New Projects*—The West demands and should have additional reclamation projects where and when feasible; recommend against any new project where the cost is so high that there is no reasonable probability of farmers being able to repay construction costs (such action will advance and not retard meritorious reclamation projects); recommend against any new projects where the probable cost of operation and maintenance, through pumping or otherwise, will be too heavy a burden for the water users to carry annually; make not only engineering studies of proposed projects, but studies of soil, climate, and markets, including kinds of fruit, grains, or other crops which the soil and climate will permit to be grown profitably; make careful study of probable annual cost of operating and maintaining a project when built, including cost of drainage systems, if the project is undertaken see to it that cost of construction is accurately calculated, so that when the work is completed an unexpected and unestimated burden does not rest upon the water users because of underestimated construction cost; in brief, establish a real, actual and helpful working co-operation with the farmer."

Federal Building Contract Form Contains Arbitration Provision

The standard form of building and construction contract to be used by all departments of the Federal Government contains provision for arbitration of disputes over time or finances, as tentatively agreed upon by the Interdepartmental Board of Contracts and Adjustments. Heretofore the general practice in Government contracts has been that there should be no appeal within the Government from the decision of the contracting officer.

The Associated General Contractors hails the adoption of this arbitration clause as "an epochal concession."

The adjustment clause as tentatively adopted is given in the following paragraphs:

"Except as otherwise specifically provided in this contract, all claims, doubts, and disputes shall be decided by the contracting officer and the contractor shall promptly proceed with the work under such decision.

"The decision of the contracting officer shall be final and conclusive except as to the element of time and the financial consideration involved, and, unless within twenty days after which decision the contractor applies in writing to the head of the department or independent establishment concerned for a review of the decision as to the elements of time and financial consideration involved, the decision of the contracting officer shall also be final and conclusive as to the questions involved in these elements.

"The head of the department or independent establishment shall promptly render his decision in writing. He may, however, before rendering his decision, refer questions raised upon review to either the board of contracts and adjustments of the department or independent establishment for which the work is being done or to the Interdepartmental Board of Contracts and Adjustments for report and recommendation thereon. His decision, when rendered, shall be final and conclusive and carried out by the parties as within the contemplation of this contract, unless within thirty days after such decision the contractor shall bring suit or give written notice to the head of the department or independent establishment of his intention to bring suit in court to determine his legal rights involved in such decision."

Members of Bureau of Housing and Regional Planning Named

Five lay members have been named to serve with three officials of New York State as a Bureau of Housing and Regional Planning in the State Department of Agriculture. The chairman of the bureau is Clarence S. Stein, an architect of New York City, who was secretary of the recent New York State Reconstruction Commission. Mr. Stein is also secretary of the Regional Planning Association of America. Another of the five lay members of the new bureau is Walter Stabler, controller of the Metropolitan Life Insurance Co., New York City. The ex-officio members include the state architect, state industrial commissioner, and Frederick Stuart Greene, state highway commissioner. An advisory commission is proposed.

Results of Engineer-Promotion Tests at Philadelphia

Announcements just made public show that there was only one candidate for the office of chief and three for that of deputy chief of the Bureau of Highways of Philadelphia, as a result of the non-assembled competitive promotion examinations.

John H. Neeson was the single candidate for chief. He has headed the Division of Street Cleaning since the city took over the work of street cleaning, garbage and ashes collection, etc., in 1921, and has been acting chief of the Bureau of Surveys since F. C. Dunlap was transferred from that position to chief of the Bureau of Water some weeks ago. It is expected that Mr. Neeson will receive the permanent appointment soon.

Percy F. Proctor led the three candidates for the position of deputy chief. He has been appointed to that position.

The two positions pay salaries of $8,000 and $6,000 a year. The examination for chief was open to all engineers in the service of the city of Philadelphia, receiving $4,000 or more per annum, while for deputy chief examinations were open to any engineer in the city service receiving $2,500 or more, the latter exclusive of the bonus. Candidates for chief were required to have an education equivalent to graduation in engineering from a university of recognized standing, besides fifteen years of general engineering experience, six years of which must have been in responsible charge and direction. For deputy chief, corresponding requisites held good except that ten years of general engineering experience and five years of highway construction and maintenance or street cleaning work were acceptable. Candidates were not required to appear at any place for written examination, but submitted a statement of their training and experience and wrote a paper on practical problems. They appeared before the Civil Service Commission for an oral interview on personal fitness. Training and experience was given a weight of 4.5; discussion of practical problems, 3; the oral interview for personal fitness, 2.5.

13 Countries Represented at Standardization Conference

An unofficial conference of the secretaries of various standardizing organizations was held early in July at Zurich, Switzerland. This was the second conference of its kind held, the first conference having taken place in London in April, 1921. At that conference the secretaries of seven standardizing organizations were present, whereas the Zurich conference was attended by secretaries of thirteen different countries—Austria, Belgium, Canada, Czechoslovakia, France, Germany, Great Britain, Holland, Italy, Norway, Sweden, Switzerland and the United States.

The conference, which lasted from July 3 to July 6, was given over to a discussion of the practical application of standards in the various countries and of the extent to which international collaboration is possible. Dr. Paul G. Agnew, of the American Engineering Standards Committee, attended.

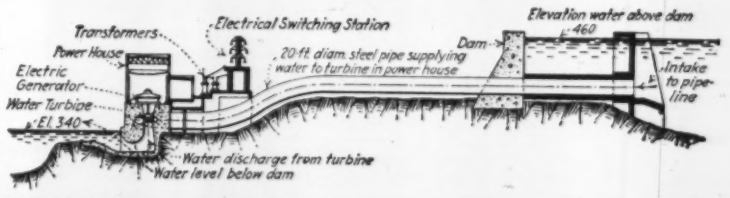
More Details of Nyack Accident Are Received

Further details of the accident which happened Aug. 9 near Nyack, N. Y., and which resulted in the death from scald and shock of six women (see *Engineering News-Record*, Aug. 16, p. 282), when a pleasure bus rammed a concrete mixer, have been received from James H. Sturdevant, division engineer of the state highway commission. Mr. Sturdevant reports as follows:

"Along the side of the freshly laid concrete, over a roadbed that had been fine graded, the first bus passed without any difficulty. The second bus struck the nut on the end of the bolt which holds the upper hand hole plate in place and pulled it to one side allowing the live steam to pour into the bus and scald its occupants. . . . There are seven uprights to hold the roof over the seats of the bus, and it was the second upright from the rear which struck the nut on the mixer."

An investigation is now being made, but as yet no report has been made to any of the state highway officials.

Power Plant Proposed for Cherokee Bluffs, Ala.



WORK will start in the near future on the Alabama Power Co.'s new hydro-electric plant at Cherokee Bluffs on the Tallapoosa River near Dadeville, Ala. This new plant will have an ultimate capacity of 132,000 hp., but the first installation will be two units of 44,000 hp. each. The Cherokee Bluffs dam will have a height of 120 ft. from the base to the top of the crest gate. It will be 800 ft. long and contain nearly 200,000 yd. of concrete. The reservoir formed by this dam will have an area of 25,000 acres, and will contain over 25,000,000,000 cu.ft. of water. This large storage capacity will make it possible to use this reservoir to regulate the flow of the Tallapoosa and Alabama Rivers. As there is no town near the site that can be used for the accommodation of workmen and their families, the Alabama Power Co. will build a town at the site which will be able to accommodate 3,000 people. It will be equipped with water supply and sewage-disposal plant, hospital, recreation hall, a commissary and mess hall, and provided with electric light and power. The total cost of the work is estimated at $10,000,000.

Random Lines

The Way Out in Germany

Sir—Further regarding "belting," "kitchen," and "exterminating" engineers! It seems that we are now going through what some of the European countries — notably Germany—experienced some fifteen or more years ago. At that time there was such a craze for the term "engineer" that every safety-pin manufacturer so dubbed himself. The term fell into considerable disrepute, or at least may be said to have lost its standing, and it was followed by the new term "Diplom Ingenieur," abbreviated "Dipl. Ing." This very rapidly solved the entire problem, for it was illegal for anyone to use the title "Diplom Ingenieur" unless he actually had a diploma from one of the recognized engineering schools. The use of the title without the prefix "Diplom" was thus an admission that the holder of it was in fact no real engineer.

It must be borne in mind however that, in Germany at least, the object was more a desire to maintain the class distinction than the purely professional purpose which it is to be hoped is the end in view in this country. W. D. B.

* * *

A Unique Specimen

INTERVIEW
BY APPOINTMENT

HARRY ERNEST HEINRICH
CONSULTING ENGINEER
THE HUMAN ENGINE
SANITARY EXTERNAL & INTERNAL REQUIREMENT
THE VOICE ITS SUPREME INSTRUMENT

STUDIO
701 HEINE BUILDING
608 STOCKTON STREET
SAN FRANCISCO

HOME ADDRESS
1318 ORDWAY
BERKELEY
PHONE BERKELEY 9878

* * *

After reading a few accounts of the coal controversy the average citizen begins to wonder how any such dispute is ever settled. Apparently the acceptance of one side's proposal by the other side is prima facie evidence to the first side that it has gone too far, so it withdraws the proposal.

* * *

Not Entirely Hopeless

Those in charge of one of our monthly magazines of review must be profoundly depressed if the contents of their August issue is any guide. Hidden among a few hopeful stories we find the following titles: "Wets Destroying Nation," "Decadent Fiction," "Focusing the Light on Our Indian Scandal." "Scrambled Households Menace Whole Fabric of Society," "Civilization Deteriorating—the Decay of Public Spirit, Disregard of the Law," etc., etc., etc. We do not belong to the Pollyanna school or hold entirely with the *American Magazine* inspirational type of current literature, but we find it hard to believe that we are going completely to the dogs here in this country. Any nation which can rise one morning to find that while it slept its ruler has died and another one already taken his place and which can then proceed with its normal business with no feeling of insecurity to add to its great sense of personal loss has gone far toward the stabilization of its whole mechanism which no amount of comparatively minor disturbances can destroy.

Montreal Increases the Capacity of Its Grain Elevators

Work on the first unit of the new grain elevators at Tarte Point, Montreal, is being carried on day and night. It will have a capacity of 2,000,000 bu. and the completed layout will have a capacity of 10,000,000 bu. The plan also calls for four traveling marine towers, for unloading from lake ships, and four unloading points for railway cars. It also provides for five berths for loading ocean ships, each berth having facilities for loading 30,000 bu. an hour, while the unloading facilities from lake ships will be able to handle 60,000 bu. an hour and from railroad cars of 48,000 bu. an hour. Work is also in progress on elevator B at Windmill Point to increase the capacity of that plant to 1,125,000 bu. This work is being done by the Montreal Harbor Commission.

Want Clearer Decision on Rate-Making Values

Washington Correspondence

Declaring that the decision rendered in the Atlanta Gas rate case was at such variance with the decisions in the Bluefield Water Works case and the Southwestern Bell Telephone case as to cast doubt as to the law, the Georgia Railway and Power Co. and its lessor, the Atlanta Gas Light Co., filed a petition in the U. S. Supreme Court on August 11 in support of their motion for a rehearing.

In rendering its decision in the Atlanta case the Supreme Court stated that the refusal of the Georgia State Railroad Commission to hold that for rate-making purposes physical property must be valued at replacement cost was correct; whereas in the Southwestern Telephone case the court said that contemporaneous reproduction cost must be taken into consideration in fixing rates for public utilities, and in the Bluefield Water case the Court said that the West Virginia Public Service Commission had not given due consideration to replacement cost.

The Atlanta Gas Company's petition also points out that its case was decided by a court of seven justices and that the other two cases were heard by a full bench. It was Judge Brandeis who handed down the majority opinion in the Atlanta case, and who rendered the minority opinion in the Southwestern Telephone case. In the latter case he stated that he differed fundamentally from the majority concerning the rule to be applied in determining whether a prescribed rate is confiscatory (*Engineering News-Record*, June 7, 1923, page 1010).

In concluding its petition the Atlanta Gas Co. states that this is the first instance in which a company has ever been denied the right to earn rates on the present value of its property.

Plans Under Way for Two New Bridges in Portland, Ore.

Bids are to be called for in September on substructures for two vehicular bridges across the Willamette River in Portland, Ore., and about the first of the year plans will be completed and bids will be invited on the superstructures. The funds for these bridges will be provided from county bonds authorized at an election last fall which allotted $3,000,000 for a new bridge where the Burnside bridge now stands and $1,600,000 for another bridge about 1½ miles further upstream.

After comparison of steel and concrete designs, concrete was selected for both structures despite the fact that it was the more costly. In the case of the new Burnside bridge the concrete arch design will cost $104,000 more than a steel structure. This bridge will have a total length of about 3,000 ft. with a 213-ft. double-leaf, trunnion-bascule center span, flanked on either side by a 255-ft. three-rib concrete arch with concrete viaduct approaches. Clearance above low water will be 65 ft. The width will be 86 ft., of which 66 to 68 ft. will be roadway.

The Ross Island bridge will have a clearance of 132 ft. above low water and no draw span will be included. This structure will be 4,000 ft. long, the channel portion consisting of six concrete arches of 270-ft. span with a rise of 90 ft. from springing line to crown. The width will be 54 ft. overall.

Hedrick & Kremers, consulting engineers, are in charge of design and construction on both bridges for the county. Traffic studies were made by J. P. Newell of the city planning commission. The Strauss Bascule Bridge Co. has the contract for the bascule span.

Bids Rejected for Delaware River Bridge Cables

Bids received Aug. 15 by the Delaware River Bridge Joint Commission for Contract No. 8 for the cables of the Delaware River Bridge were rejected because they exceeded the appropriation. Work will be readvertised and another opening held Sept. 19. Only two firms bid, as follows:

	Item	Estimated Quantities	Frederick Snare Co., New York		Oscar Daniels Co., New York	
			Unit Price	Amount	Unit Price	Amount
1	Wire cables	lump sum	.....	$2,622,000	.....	$2,741,000
2	Suspender rope	105,000 ft.	$1.82	191,100	$1.70	178,500
3	Steel castings	1,020,000 lb.	.16	163,200	.25	255,000
4	High tensile bolts	100,000 lb.	.15	15,000	.25	25,000
5	Hand ropes	lump sum	.....	6,800	.....	7,000
6	Structural steel	90,000 lb.	.20	18,000	.20	18,000
7	Cast iron	30,000 lb.	.12	3,600	.15	4,500
	Total bid			$3,019,700		$3,229,000

The bids cover the construction of the two cables of the bridge, together with suspenders, but do not include wrapping of the cables. The cables will be larger than any previously constructed, each one being 30 in. in diameter, and composed of 18,666 separate parallel wires of No. 6 gage, galvanized wire, 0.196 inches in diam. The cables will have a sag of 200 feet, and a length from anchorage to anchorage of approximately 3,560 feet. The cable band castings for attachment of the suspender ropes, the anchorage collar castings and all other cast steel portions are to be of electric furnace cast steel.

World Power Conference Planned for Next Year

British Electrical and Allied Manufacturers Sponsors for London Session

During the summer of 1924 there will be held in connection with the British Empire Exhibition in London a World Power Conference initiated by the British Electrical & Allied Manufacturers Association, Inc., but participated in by many technical and scientific institutions and industrial organizations in Great Britain and other countries. The object of the conference will be to consider how industrial and scientific sources of power may be adjusted nationally and internationally.

The objects of the conference are to achieve by: considering the potential resources of each country in hydro-electric power, oil, and minerals; comparing experiences in the development of scientific agriculture, irrigation and transportation by land, water, and air; conferences of civil, electrical, mechanical, marine, and mining engineers, technical experts and authorities on scientific and industrial research; consultations of the consumers of power and the manufacturers of the instruments of production; conferences on technical education to review the educational methods in different countries and to consider means by which existing facilities may be improved; discussions on the financial and economic aspects of industries, nationally and internationally; and conferences on the possibility of establishing a permanent world bureau for the collection of data.

The conference probably will divide itself into the following sections: Power resources, power development, power application, and the economic and financial aspects of power.

Americans to Participate

In response to invitation for American participation in the conference, twenty or more American engineering, technical and industrial organizations have appointed representatives to a committee of arrangements which has planned an organization with John W. Weeks, Secretary of War and chairman of the Federal Power Commission, as honorary chairman, and O. C. Merrill, executive secretary of the Federal Power Commission, general chairman.

Following conferences in London with Mr. Merrill and J. B. Challies of Canada, officials of the World Power Conference have agreed upon a tentative program. Participation of all western Europe except Russia and Germany is assured. It is planned to feature a concise statement of the existing situation in each country and to discuss conditions under which capital of one country can be invested in utility enterprises in another. All papers to be presented will be printed in advance so that the entire time of delegates at the meetings may be devoted to discussion. British manufacturers are convinced that they benefit greatly by improving the status of the engineer and a studied effort will be made to make this conference helpful to the engineer.

The organizing director of the World Power Conference is D. N. Dunlap, secretary of the British Electrical & Allied Manufacturers Association.

Engineering Societies

Calendar

Annual Meetings

NEW ENGLAND WATER WORKS ASSOCIATION, Boston, Mass.; Annual Convention, Burlington, Vt., Sept. 18-21, 1923.

INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS, Chicago, Ill.; Annual Conference, Chicago, Sept. 27-28, 1923.

AMERICAN PUBLIC HEALTH ASSOCIATION, New York; Annual Meeting, Boston, Oct. 8-11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Fall Meeting, Richmond, Va., Oct. 17-20.

AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, St. Petersburg, Fla.; Annual Convention, Atlanta, Ga.; Nov. 12 to 16.

The American Institute of Architects, Denver Chapter, has given to the library recently established by the Colorado Engineering Council, technical books valued at more than $5,000. The engineers' library is maintained at the Denver Public Library.

Personal Notes

LESTER L. LESSIG has been made assistant contracting engineer of the Philadelphia office for the McClintic-Marshall Co., with address in the Morris Bldg., Philadelphia. For the past two and one-half years Mr. Lessig has been assistant to the chief engineer of this company.

COL. CHARLES KELLER, who resigned as engineer-commissioner of the District of Columbia in April to investigate the possibility of engaging in hydro-electric work in the West, and who was granted a leave of absence from the Corps of Engineers, has had that leave extended another two months, thus being retained on the active list. Col. Keller is business manager for the El Dorado project being constructed by the Western States Gas & Electric Co.

CHARLES H. ENSIGN, construction engineer of Cleveland, Ohio, and MARK G. SNOW, recently engineer of roadway, track and bridge costs with the Froelich & Emery Engineering Co. on the appraisal of the interurban railways of the state of Michigan for the public utilities of that state, have established offices at 517 National Bank Bldg., Cleveland, Ohio, for the practice of civil, architectural and appraisal engineering, under the name of ENSIGN AND SNOW.

JOHN G. SULLIVAN, consulting engineer, Winnipeg, Canada, is president of a new company organized in that city under the name of the Canadian Engineering & Construction Co., Ltd., which will do general engineering and construction work and which has secured a contract for building 51 miles of high-tension line for the Manitoba Power Commission. The company will act as consulting, supervising and constructing engineers and in an advisory capacity to railways. Mr. Sullivan has been in private practice in Winnipeg since 1918. Before that he was chief engineer of the Western Lines of the Canadian Pacific Ry. He is a past president of the Engineering Institute of Canada. The vice-president of the new firm is Theodore Kipp, head of the firm of Kipp-Kelly, Ltd., and the secretary is C. A. Monkman who has been with the Manitoba Steel & Iron Co., Ltd.

PERCY CUPPER, state engineer of Oregon for five years and with the state engineering department for some eighteen years, was removed from office August 1, without notice, by the new governor of Oregon and was replaced by RHEA LUPER who has been assistant state engineer for fourteen years. Reasons for the change are ascribed wholly to politics. Mr. Cupper, who has been admitted to the bar, will open an office in Salem, Ore., it is reported, for the practice of irrigation law.

MAJOR JAMES F. CASE sailed August 18 for Montevideo, Uruguay, where he will take up his duties as chief consulting engineer for Ulen & Co., Inc., New York City, in connection with hydro-electric construction works in South America. Major Case has had long and varied experience with work of this kind in the Pacific Northwest and the Philippine Islands, and has reported on properties and projects in Italy, Spain, France, Mexico and Venezuela. As director of public works in the Philippine Islands from 1901 to 1910 he made exhaustive studies of the water-power possibilities of the Islands and in 1918-1922 studied and reported on the principal hydro-electric properties in Northern Italy. He is a Membre d'Honneur des Ingenieurs Civils de France and member of Joint Committee on Co-operation Between International Technical Bodies, appointed by the four founder societies in the United States together with the engineering societies of England, France and Italy.

LIEUT.-COL. WILLIAM B. CAUSEY, who since 1919 has been technical adviser to Austria, has been appointed city manager of Norfolk, Va., at a salary of $20,000 per year. Colonel Causey was born in Suffolk, Va., 58 years ago. From 1883 to 1890 he was engaged in railway work in various capacities with the Atlantic & Danville R.R., the Suffolk & Carolina R.R. and the Union Pacific R.R. and then for a year was in private practice in Suffolk, Va. Then followed promotions in railway work from assistant superintendent, Milwaukee Division, to division superintendent, Chicago & Northwestern Ry., chief engineer of Elgin, Joliet & Eastern and Chicago, Lake Shore & Eastern Rys. From 1914 to 1917 he was vice-president of the Norwood, White Coal Co., Des Moines, Iowa, and fuel agent for the Buick Motor Co., Flint, Mich. Between 1917 and 1919 he served as captain and major in the 17th Engineers, a railway shop regiment, and lieutenant-colonel, Engineers, U. S. Army, in charge of hospital, camp, warehouse, dock and railway construction at Nantes and other places in Base Sec. 1 in France; in 1919 he was made president of the Allied Railway Mission, at Trieste and Vienna and American member of the Danube River Commission.

C. O. FASS, chief engineer of the New Brunswick Electric Power Commission, has resigned.

R. W. ARMSTRONG has been appointed division engineer of the Northwest division of the Kansas State Highway Commission with headquarters at Concondia, Kan. Mr. Armstrong was formerly resident engineer on federal-aid projects in Doniphan County.

PROF. FRANK P. MCKIBBEN, of Union College, has been appointed a member of the City Planning Commission of Schenectady, N. Y.

E. G. SHIEBLEY, who served during the World War as a sanitary engineer in the U. S. Public Health Service, has been appointed sanitary engineer for the city of Los Angeles, Calif., in charge of sanitation and housing problems.

Obituary

WALTER SMITH, for many years a member of the organization of the Atlas Portland Cement Co., died August 1, 1923, at his home in Des Moines, Iowa, after a brief illness.

JOHN C. TEMPLE, hydraulic engineer and for the past fifteen years manager of the Chicago office of S. Morgan Smith Co., died suddenly August 8 in Davenport, Iowa; he was 65 years of age. Mr. Temple at an early age became interested in the hydraulic turbine industry, his father being one of the original members of the firm of Stout, Mills & Temple, Dayton, Ohio, who were among the pioneer water wheel builders of the country. His entire career was devoted to water power engineering and the manufacture and sale of hydraulic turbines and accessories, and covered experience in Philadelphia, New York City and Montreal, also exploration of water power possibilities in Mexico and Central America. He joined the S. Morgan Smith Co. twenty years ago.

THOMAS ELLIS BROWN, for the past twenty years consulting engineer to the Otis Elevator Co., a pioneer in the design and construction of hydraulic and electric elevators, and the originator of the Brown type of bascule bridge, died of heart disease at his home in Morristown, N. J., Aug. 15, after a month's illness. He was 67 years of age. Shortly after graduation from Columbia University Mr. Brown was assistant to Prof. Shunk, of that institution in railway and topographic instruction. Later he became assistant engineer in charge of the design and construction of a part of the Ninth Ave. Elevated structure, New York City. About 1884 Mr. Brown joined the engineering staff of the Otis Elevator Co., becoming its chief engineer. He acted in that capacity until about 20 years ago when he established consulting offices; however, he was retained as a consultant by the Otis company until his death. One of the notable achievements of Mr. Brown was the design and installation of the elevators in the Eiffel Tower, in Paris. The first installation of his bascule bridge was made at Buffalo, N. Y., and was described in *Engineering News* Jan. 16, 1908, p. 51.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Standards Adopted for Tilting Mixers

Joint Committee Agrees On Three Sizes, 3½, 5 and 7 cu.ft.—Name-plate to Show Rating

At a meeting in Chicago, July 30, a joint committee of manufacturers of tilting concrete mixers and contractors agreed upon standards for the equipment under consideration. The following detailed report on the action of the meeting supplements the news article which appeared in *Engineering News-Record*, Aug. 9, p. 244:

1. *Standard of Measurement.*

(a) The standard of measurement of drum capacity shall be the cubic foot.

(b) The standard for water-tank measurement shall be the U. S. standard gallon.

(c) It is recommended that the question of rating engines and motors be taken up by the Joint Committee on Construction Equipment in conjunction with engine and motor manufacturers.

2. *Rating of Mixers.*

The size of the mixer shall be designated by a number indicating the nominal rating of the mixer according to its capacity in cubic feet of mixed concrete per batch.

3. *Table of Aggregate Proportions.*

A standard table of mixed aggregates derived from authoritative sources shall be adopted and published by the manufacturers. This table, based upon 40 per cent of voids in the course aggregate and 3.8 cubic feet of cement per barrel is as follows:

Proportions Of Mix	Resultant Concrete per Bag, Cu.Ft.	Proportions Of Mix	Resultant Concrete per Bag, Cu.Ft.
1:1½:3	3.55	1:2½:4	4.85
1:1½:3½	3.86	1:2:5	5.13
1:2:3	3.89	1:2½:5	5.47
1:2:3½	4.20	1:3:5	5.83
1:2:4	4.52	1:3:6	6.50

Values taken from Taylor and Thompsons' Tables of Aggregate Proportions.

4. *Sizes.*

It is recommended to mixer manufacturers that two sizes under 7-S be adopted as standard; namely, the 3½ and the 5 cu.ft.; and that sizes below the 3½ be omitted from the standardization program for the present.

5. *Standard Table of Batches.*

A standard table of batches based upon the table of mixed aggregates provided under Article 3, shall be adopted and published by the manufacturers. This table is as follows:

The resultant concrete per bag is based upon 3.8 cu.ft. of cement per barrel and 40 per cent of voids in the coarse aggregate.

Building mixer batches are based upon 1½ gal. of water per cubic foot of mixed concrete.

Paving mixer batches are based upon 1 gal. of water per cubic foot of mixed concrete and upon a maximum operating grade of 8 per cent.

6. *Standardization of Mixer Equipment.*

(a) The 3½ and the 5 cu.ft. mixers may be equipped with power loaders and water tanks.

(b) Pressure water tanks shall withstand a working pressure of 150 lb. per square inch.

(c) Water connections on the 7-S and under shall be ¾-in. garden hose connections.

(d) Loading skips shall be made with closed ends on the 7-S and under.

(e) Auxiliary hoisting drums may be furnished on the 7-S and under.

7. *Shafts, Keys and Keyways.*

A. S. M. E. sizes of shafts, keys and keyways shall be used.

8. *Safety Devices.*

All working parts shall be guarded in accordance with the requirements of state laws.

9. *Standard Nomenclature.*

The nomenclature of the Concrete Mixer Association, with such additions as may be later approved by the manufacturers, shall be adopted as standard.

10. *Name Plate.*

(a) A name plate giving the standard rating of the machine and its capacity for different proportions of mix shall be affixed to each machine.

(b) Pending adoption of American Standards, the plate shall state that the machine meets the standard A. G. C. requirements as approved by the Joint Committee of Mixer Manufacturers and Contractors. (Note: A standard plate was adopted.)

(c) Until such time as the Associated General Contractors can take definite steps for approval of batch capacities of the standard mixers each manufacturer shall furnish to the A. G. C. an affidavit stating that the machines comply with the standards and will satisfactorily mix the batches listed on the name plate.

11. *Use of Standard Plates.*

(a) Manufacturers conforming to these standard requirements shall be allowed the use of the A. G. C. name plate—it being understood that due to manufacturing and competitive condi-

CAPACITIES OF STANDARD SIZE MACHINES FOR VARIOUS PROPORTIONS OF MIX

Proportions of Mix	Resultant Concrete per Bag Cu.Ft.	Building Mixers — Max. No. Full Bags per Batch						Paving Mixers — Max. No. Full Bags per Batch			
		3½-S	5-S	7-S	14-S	21-S	28-S	7-E	12-E*	13-E*	21-E
1–1½–3	3.55	1	1	2	4	6	8	1	3	3	6
1–1½–3½	3.86	½	1	1	3	5	7	1	3	3	6
1–2 –3	3.89	½	1	1	3	5	7	1	3	3	6
1–2 –3½	4.20	½	1	1	3	5	7	1	2	3	5
1–2 –4	4.52	½	1	1	3	4	6	1	2	3	5
1–2½–4	4.85	½	1	1	3	4	6	1	2	2	4
1–2 –5	5.13	½	½	1	3	4	6	1	2	2	4
1–2½–5	5.47	½	½	1	2	4	5	1	2	2	4
1–3 –5	5.83	½	½	1	2	3	5	1	2	2	4
1–3 –6	6.50	½	½	1	2	3	4	1	1	2	3

* Either the 12-E or the 13-E is to be eliminated, depending upon results of a referendum to the A. G. C.

tions it may be necessary for manufacturers to continue their present non-standard sizes—it being further the sense that the manufacture of such non-standard sizes shall be eliminated by Jan. 1, 1925.

(b) After Sept. 1, 1923, any manufacturer bringing out a new size of mixer not in accordance with the established standards, shall forfeit his right to the use of the A. G. C. name plate so long as he departs from the standards, it being understood that mixers larger than 28 cu.ft. and under 3½ cu.ft. are not considered.

Adopt "Corduroy" as Trade Mark

To differentiate the type of traction employed on their revolving shovels, cranes and draglines from other similar types of endless chain tractions Pawling & Harnischfeger, Milwaukee, have adopted as a trade mark the word "Corduroy" worked into the design shown below.

CORDUROY

Excavators, the company points out, are called upon to do considerable traveling over soft ground. The first machines, which were mounted on wheels, used mats when operating in, or crossing, soft soil. The mats really amounted to short sections of corduroy road which were transported with the machine. They were picked up from the rear as the machine traveled along and set in front again, a slow process.

P&H Excavators were developed upon the principle of carrying and laying their own corduroy road. The traction consists of an endless chain of steel treads which are, in effect, the logs of a corduroy road since they lie close together and form a path upon which the machine travels. The first machines built by the P&H company had blocks of wood bolted crosswise onto the endless chains of the traction device, and the P&H design, therefore, is described as a Corduroy traction.

Lumber Course, by Mail, Has 3,000 Students

Three thousand students are now enrolled in the free correspondence course in lumber and construction information conducted by the National Lumber Manufacturers Association, and a goal of 6,000 is set for the season's enrollment. The purpose of the course is to give lumber merchants and others a background of knowledge of their material and its application in construction. The course consists of sixteen chapters on such subjects as merchandising, technical and physical properties of lumber, planning and designing, estimating and rules for taking off quantities, figuring stresses and sizes, shingles, wood preserving, heavy timber mill construction, blue print reading, and commercially important trees.

The student requests one chapter at at time from the National Lumber Manufacturers Association, International Building, Washington, D. C., or Conway Building, Chicago, Ill., and after having reported studying successively the sixteen chapters receives a certificate of graduation.

Contractors' Vote Favors 21-S Concrete Mixer

Of 132 Ballots Cast 83 Indicate a Need for the Three-Quarter Yard Size on Construction

BY a vote of 83 to 49 members of the Associated General Contractors of America have gone on record in favor of retaining as one of the standard sizes the 21-S concrete mixer which was the subject of a ballot sent out after the meeting in Chicago, June 27-29, of the Joint Committee on Construction Equipment (see *Engineering News-Record*, July 26, p. 160). Some of the members gave the following reasons in explanation of their vote favoring or opposing the 21-S size:

IN FAVOR

This size fits more jobs than any of the larger sizes.—Yakima Paving Co., Yakima, Wash.

Would give 21-S preference over 14-S or 28-S. Have been using for 12 years on our larger building operations.—Lundoff-Bicknell Co., Cleveland.

On work requiring rich mixtures 21-S is a size of value; many such jobs are overplanted with a larger mixer.—F. L. Cranford Co., Brooklyn.

Three-quarter yard mixer most desirable for work on buildings in general.—Henry Ericson Co., Chicago.

I prefer 21-S because more easily handled, costs less and is more economical. It is large enough for any ordinary building construction.—W. T. Hadlow, Jacksonville.

21-S considered more flexible than 28-S; operating satisfactorily and arguments do not warrant discontinuance.—John J. Kane & Co., El Paso.

21-E paver fits in more economically and is better adapted to general run of work than other sizes.—Crissey Constr. Co., Johnstown, Pa.

21-S is most convenient size for moving and installing; large enough for big jobs and not too large for medium size jobs.—H. B. Sproul Construction Co., Scranton.

While 28-S will do the work, its weight makes transportation and installation a serious matter. We should be very sorry to see 21-S go—we use it constantly.—Arthur S. Bent, Los Angeles.

We find 28-S too cumbersome to handle on our city jobs, where most times available space for plant is limited. We use 7-S, 14-S and 21-S, but no 28-S. —Walbridge & Aldinger Co., Detroit.

OPPOSED

A job justifying anything larger than a 14-S is suited to a 28-S.—Hogan & Humphrey, Little Rock, Ark.

Three-quarter yard mixer too large for a side loader. If large mixer is desired on large work, fed from bins and hoppers above, a 1-yard mixer is preferable—for medium sized work and under a one-half yard mixer does the work nicely.—E. L. Scheidenhelm, Chicago.

On a job requiring large mixer, 28-S is just as economical even when operated at three-quarter yard capacity, and, on a small job, 14-S is sufficient.—Wolverine Engineering Co., Mason, Mich.

We use 21-S least of all. On large jobs have not used 21-S since 1920.—John J. Turner & Sons, Amsterdam, N. Y.

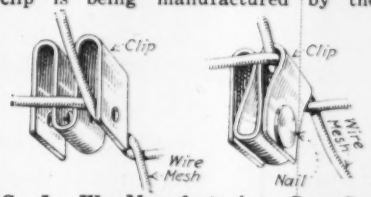
Business Notes

PIONEER INSTRUMENT CO., Brooklyn, N. Y., has purchased the business of Brandis & Sons, Inc., including their factory and equipment. The latter company has made engineering and nautical instruments since 1872, while the Pioneer company manufactures aircraft instruments exclusively. Each organization will continue the sale of its own product. Their manufacturing facilities will be combined, however, and operated as one plant. William F. and Henry A. Brandis will continue as president and vice-president of Brandis & Sons. Both companies will occupy the Brandis building at 754-758 Lexington Ave., Brooklyn.

Equipment and Materials

Furring Clip for Wire Mesh

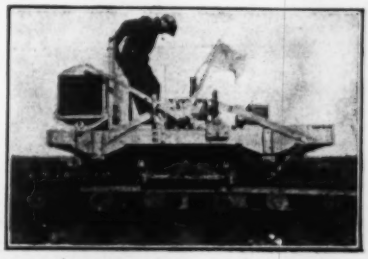
For holding wire mesh at the proper distance from surfaces to be plastered or covered with stucco, a simple furring clip is being manufactured by the



G. L. W. Manufacturing Co., San Diego, California. The clip, as shown in the accompanying illustration, consists of a bent strip of galvanized metal which is hung over the wire and fastened with a four-penny nail.

Track Shifting Car

A machine for shifting track laterally or raising it vertically has been placed on the market recently by the Lake Superior Loader Co., Duluth, Minn., and is shown in the accompanying view. This machine is adapted for shifting dump-car tracks on railway or

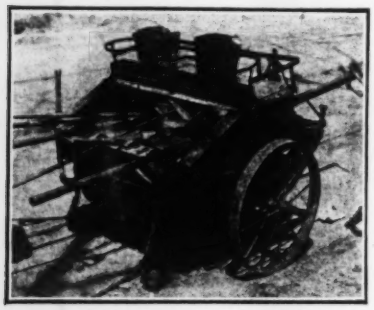


other construction, coal and ore stripping and similar work. In fact it is the development of a machine which has been in use for some months in shifting track on the waste dump of an iron ore mine in Minnesota. The four-wheel car, 10 x 7 ft. in size, has at the center a 7-ft. vertical spud raised and lowered by a rack and pinion, and fitted with a broad shoe on the bottom. The pinion mechanism has a lateral travel across the floor of the car. In operation, four rail tongs attached to the car frame are clamped to the rails.

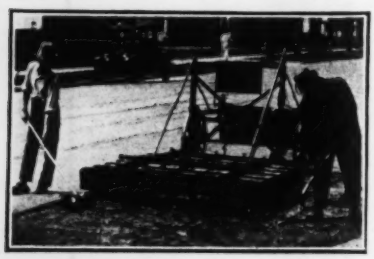
The spud is inclined in the direction the track is to be shifted and is racked down so as to lift the car, carrying with it the rails and ties. Owing to the inclination of the spud the whole structure slides laterally until the ties again rest on the ground. The tongs and spud are then released and the car is moved forward about two rail lengths to repeat the operation. A gasoline engine drives the car and operates the spud gear. The machine weighs about 2½ tons. It is stated that this machine with one man has replaced eight men in a track gang engaged in shifting track on ore stripping work. Track can be raised in the same way (without shifting it laterally) for ballasting, tie renewals or raising grade.

Oil Burning Tool and Surface Heaters for Asphalt Repairs

Improvements in its oil-burning tool and surface heaters for the repair of asphalt pavements, originally introduced about five years ago, are announced by the Chausse Oil Burner Co., Detroit. The tool heaters, illustrated in the accompanying photograph, are now equipped with Timken bearings, steady rests and a new type of burner. Rubber tires may be added to make possible



more rapid and noiseless transportation when hauled by motor truck. Fuel tanks provide sufficient kerosene or distillate for two 8-hr. days of continuous burning at maximum temperature. The tool heaters will bring fourteen or fifteen cold tools up to proper temperature in 15 min. and provide space for heating three buckets of asphaltic cement, so that two gangs can work with one machine. The burners generate maximum temperature in 5 min., eliminating the

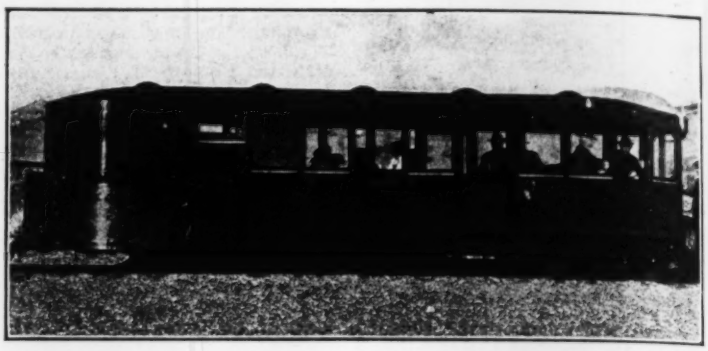


necessity of building up coal or wood fires long in advance of the use of the machine. With the oil fuel employed there is no nuisance or danger from smoke, sparks or ashes.

The surface heaters are made in two sizes; one to cover 2 sq.yd. to work up to street car tracks without interfering with car movement, and the other to cover 4 sq.yd. Both machines are mounted on springs to facilitate transportation. With these heaters, the manufacturer states, it has been found possible to melt down old asphalt to a 1-in. depth in 4 to 5 min.

New Type of Light Gas Car For Narrow-Gage Railway

A new type of self-contained gasoline-driven railroad motor car has been supplied to the Nevada-California & Oregon Ry. Co. by The A. Meister Sons



Co. The cars are built to operate on 36-in.-gage track. On a test run of 520 miles one of them averaged 11 miles to a gallon of gasoline and less than one pint of lubricating oil. The average speed was 35 m.p.h. and the maximum 55 m.p.h. The car carried 28 passengers and negotiated grades of 2½ per cent. The car weighs 8 tons.

The length of the car is 32 ft. and the width 7 ft. The distance between the rear drivers and the center of the bolster bar on the front truck is 20 ft. The height from top of rails to center of roof is 8 ft., and from top of rails to floor of car 14 in. These cars are operated by one man, from the front end of car. They are equipped with 4-cylinder motors, Arcola hot water heater system, and electric starter, generator, lights and horn. There is absolutely no noise in the car body, this being due to the rubber cushion springs. By placing the motor to the rear of the driving wheels, all revolving parts in front of the rear axle have been eliminated, thereby permitting a very low-hung car and eliminating all motor noise, smoke, grease and gasoline odor from the inside of the car.

Practically all vibration has been eliminated by suspending the motor on coil springs directly over the rear axle, on one end of a sub-frame. This sub-frame has a swivel bolster bar built in the main frame at one end so that it will turn at curves, thus eliminating flange wear and relieving side thrust.

The car is equipped with a Westinghouse accumulator, taking air from the front cylinder, this air being used for sanders only. The breaking power is 175 per cent.

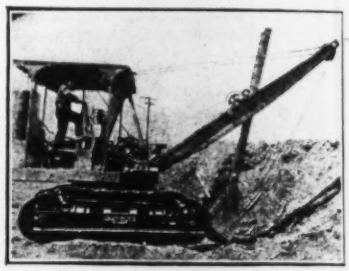
Similar cars are built in all gages from 2 ft. up.

Gasoline Dipper Shovel

A gasoline-driven power shovel operated entirely with gears and shafts and known as the O. S. Dependable, is announced by the Orton & Steinbrenner Co., Manufacturers of cranes, shovels, and buckets, of 608 So. Dearborn St. Chicago. The positive gear drive, the feature of the O. S. Dependable, is simple and the number of parts few. At the bottom of the boom connection is a shaft carrying double steel bevel gears and bronze friction clutches. This shaft is concentric with the pivot of the boom and consequently independent of its position. The boom can be used at any angle to suit the exigencies of the work.

Along the boom is a steel shaft carrying two bevel pinions, one meshing at the bottom with the gears on the horizontal shaft, and the other at the top meshing with gears on a countershaft located about half way up the boom. This latter shaft carries a brake and "slip friction," and is geared directly to the cast steel rack on the dipper stick. With this method, a minimum number of levers are required.

The hoisting mechanism is the same type as has been used in the locomotive



cranes built by the Orton & Steinbrenner Co. for fifteen years. The simplicity of parts is also of great advantage in converting the shovel into a clamshell outfit, dragline, or skimmer rig. The power is supplied by a heavy duty 4-cylinder "Climax" motor. Another exclusive feature of the machine is the flexible crawling tread.

Publications from the Construction Industry

Grab Bucket Cranes—PAWLING & HARNISCHFEGER CO., Milwaukee, Wis., has just issued a new bulletin covering its complete line of traveling grab-bucket cranes and monorail hoists. This bulletin has 32 pages and is freely illustrated with pictures of the various kinds of grab-bucket equipment and many views showing its installation in various industries.

Electrical Development—GENERAL ELECTRIC CO., Schenectady, N. Y., has issued to its stockholders a 34-p. booklet reviewing the 30 years' history of the company from its foundation in 1892 to 1922.

Air Compressors — INGERSOLL-RAND Co., New York, has issued a new 35-p. illustrated bulletin describing its medium and large sized steam-driven air and gas compressors built in a number of types and sizes. The capacities of the standard two-stage machine for 100 lb. discharge pressure range from 246 to 4150 cu.ft. per minute piston displacement. Single-stage compressors are built for furnishing 50 lb. discharge pressure. A feature of the equipment is the steam valve gear consisting of completely balanced piston valves with riding cut-off valves telescoping within the main valves. An automatic cut-off governo. maintains constant air pressure, regulates the steam cut-off and adjusts the speed of the compressor to the demand for air.

Lumber in Architectural Construction — SOUTHERN PINE ASSOCIATION, New Orleans, has published in the form of a 16-p. booklet recommendations for the use of Southern Pine lumber in architectural construction, covering grades and sizes in accordance with the association's standards which have been approved by the Louisiana Chapter, American Institute of Architects, The General Contractors Association of New Orleans, and the New Orleans Retail Lumber Dealers.

Turbine Pumps—LAYNE & BOWLER Co., Memphis, Tenn., describes and illustrates its turbine pumps and well screens for railroad, mining, industrial, municipal and irrigation service in a 64-p. catalog just issued. Details are given regarding the Layne shutter screen for large bore wells, and also the Keystone wire wrapped screen manufactured of perforated pipe covered with a spiral brass winding. One chapter of the text is devoted to the development of underground water supplies. Complete data are given regarding the company's vertical turbine well pump and a number of typical installation views are shown.

Gasoline Motors—WAUKESHA MOTOR Co., Waukesha, Wis., in a 32-p. illustrated pamphlet, illustrates and describes its industrial power unit consisting of a 4-cylinder gasoline engine in sizes of from 20 to 45 hp. The unit is housed with sheet metal, is portable, and is recommended for use in operating sawmills, hoists, pumps, stone crushers, concrete mixers, air compressors and road machinery. The power take-off is a housing that can be attached to the flywheel housing of any Waukesha motor.

Waterproofing—GENERAL FIREPROOFING Co., Youngstown, Ohio, in the sixth edition of its "Waterproofing Handbook" describes methods and materials for waterproofing concrete and all forms of masonry, both above and below grade, and protecting finished surfaces of wood, plaster, concrete or metal against water, wear and stains. The volume comprises 72 p., illustrated, divided into five parts dealing with substructural waterproofing, superstructural waterproofing, cement and wood floor preservation, technical paints and coatings, and the company's waterproofings and preservatives. The text is supplemented by a number of photographs and drawings indicating waterproofing details.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Freight Movement for Half Year Greatest in Railway History

The railroads of the United States during the first six months this year carried the greatest freight traffic for any corresponding period in their history, according to tabulations just made by the Bureau of Railway Economics, based on reports filed by the carriers. Measured in net ton-miles, it amounted to 225,435,608,000, an increase of 7 per cent over the corresponding period in 1920 which had marked the previous record.

TON-MILEAGE FIGURES

Compared with the first half of last year when, however, freight traffic was reduced by the miners' strike which began on April 1 and continued until late in the summer, the total net ton-miles for the first six months this year was an increase of more than 32 per cent. In the Eastern district, which was especially affected by the miners' strike, there was an increase over the first six months last year of 37.6 per cent in freight traffic, while the Southern district reported an increase of 29½ per cent. In the Western district the increase was 26 per cent.

For the month of June alone freight traffic amounted to 38,000,994,000 net ton-miles, or an increase of nearly 31 per cent over the same month last year when the miners' strike was in progress. The Eastern district showed an increase of more than 46 per cent in freight traffic, the Southern district 14 per cent and the Western district 17 per cent. Freight traffic in June this year has only been exceeded twice during that month in previous years, once in June, 1917, and again in the month of June, 1920.

AVERAGE CAR MOVEMENT

The average movement per freight car during the month of June was 28.3 miles per day. This was the highest average for any June since 1917 when it was exceeded by 0.1 mile. It also was an increase of 4.4 miles over June last year, and 6.3 miles over June, 1921, but a decrease of 0.3 mile under the daily average for May this year. Every increase of one mile in the average movement of a freight car is equivalent to the addition of 100,000 freight cars to the country's transportation facilities without any increase in capital expenditures.

The average load per car in June was 28.2 tons. This was not only an increase of 0.2 ton over the average for May this year but was the highest average for any June since 1917, except in 1918 when the average was 28.3 and in June, 1920, when it was 28.9.

Bookings of Steel Castings

July bookings of steel castings, based on reports received by the Bureau of the Census of the Department of Commerce amounted to 52,066 tons, as against 84,878 tons in June, representing two-thirds of the commercial castings capacity of the United States. The following table shows the bookings of commercial steel castings for the past seven months by 65 identical companies, with a monthly capacity of 96,900 tons, of which 38,300 tons are usually devoted to railway specialties and 58,600 tons to miscellaneous castings.

BOOKINGS OF COMMERCIAL STEEL CASTINGS

Month 1923	Total — Net Tons	Total — Per Cent of Capacity	Railway Specialties — Net Tons	Railway Specialties — Per Cent of Capacity	Miscellaneous Castings — et Tons	Miscellaneous Castings — Per Cent of Capacity
January	100,605	103.8	47,879	125.0	52,726	90.0
February	90,152	93.0	39,845	104.0	50,307	85.8
March	143,564	148.2	76,409	199.5	67,155	114.6
April	90,968	93.9	39,610	103.4	51,358	87.6
May	89,493	92.4	38,788	101.3	50,705	86.5
June	84,878	87.6	42,773	111.7	42,105	71.9
July*	52,066	53.7	16,741	43.7	35,325	60.3

* Two companies with a capacity of 785 tons per month on miscellaneous castings now out of business.

Industrial Employment in July

The U. S. Department of Labor, through the Bureau of Labor Statistics, presents the following preliminary figures concerning the volume of employment in July, 1923, from 6,739 representative establishments in 51 manufacturing industries, covering 2,353,258 employees whose total earnings during one week in July were $61,174,094. The same establishments in June reported 2,396,012 employees, and total pay rolls of $64,176,205. Therefore in July, as shown from these unweighted figures for 51 industries combined, there was a decrease under June of 1.8 per cent in number of employees, a decrease of 4.7 in total amount paid in wages, and a decrease of 2.9 in average weekly earnings. This decrease in employment, the first appearing in this series of reports since April, 1922, is largely a seasonal one.

Increases in rates of wages for the month ending July 15 were reported by 302 establishments in 48 of the 51 industries covered. These increases averaged 8.5 per cent and affected 31,829 employees, or 35.3 per cent of the employees in the establishments concerned, and 1.4 per cent of all employees in the 51 industries.

Forty-one industries out of 51 show decreased per capita earnings in July as compared with 27 out of 50 in June.

Freight Cars in Need of Repair

The railroads of the United States on Aug. 1 had 189,014 freight cars or 8.3 per cent of the total number on line in need of repair. This was an increase of 393 over the total number in need of repair on July 15, at which time there were 188,621 or 8.3 per cent. Compared with the number on July 1, it was a decrease of 1,397. Of the total number on Aug. 1, this year, 144,566 or 6.3 per cent of the number on line were in need of heavy repair, an increase over the number in need of such repair on July 15 of 1,285.

Lumber Movement Declines

The nation's lumber movement declined noticeably during the week ending Aug. 11, says the National Lumber Manufacturers Association, as reflected by reports from 382 of the larger commercial sawmills as compared with reports from 406 mills for the preceding week. Shipments fell off about 15 per cent, new business about 10 per cent, and production about 7 per cent. With 122 mills reporting as against 131 for the week before unfilled orders of West Coast mills decreased from 320,039,832 ft. to 305,893,356 ft.; and 132 Southern Pine Association mills show a decline in the order file from 228,868,185 ft. to 218,769,525 ft.

For all the reporting mills shipments were 82 per cent and orders 78 per cent of actual production; for the Southern Pine mills these percentages were 95 and 81, and for the West Coast mills 85 and 98. Of the whole number of reporting mills 343 have an established nominal production for the week, in reference to which actual production was 102 per cent, shipments 88 per cent, and orders 85 per cent.

Wholesale Prices in Italy Up

Wholesale prices in Italy have notably increased during the past year, according to index numbers complied by the Chamber of Commerce of Milan. In June, 1922, taking average prices for 1913 as 100, the general index stood at 504.48, and in June, 1923, it had risen to 539.24. The groups showing the largest increase is textile materials, which have risen from 556.44 to 653.91. Minerals and metals have also increased considerably. Food products show a further increase from 549.05 to 564.66.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the the issue of Aug. 2; the next, on Sept. 6.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.64	$4.00	$4.20	$3.40	$3.55	$4.20	$3.60	$4.10	—$4.00
Structural rivets, 100 lb.	4.40	4.75	4.90	3.75	4.25	5.40	5.00	4.75	6.00
Reinforcing bars, ¾ in. up, 100 lb.	3.54	—3.50	3.80	3.20	3.45	3.85	3.65	4.10	—3.90
Steel pipe, black, 2½ to 6 in. lap, discount	44%	52%	45%	47%	53–5%	36%	33.2@42.2%	40%	47.43
Cast-iron pipe, 6 in. and over, ton	62.30	56.00	63.00	60.20	60.50	69.00	62.00	70.00	60.00
Concreting Material:									
Cement without bags, bbl.	2.70@2.80	3.00	2.25	2.20	2.50	2.84	2.63	2.90	2.25
Gravel, ¾ in., cu.yd.	1.75	1.90	2.38	2.00	1.85	1.90	2.15	1.25	1.50
Sand, cu.yd.	1.25	1.24	1.89	2.00	1.25	1.00	1.50	1.25	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.83	2.00	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	58.00	40.00	52.25	56.50	42.50@43.75	42.75	41.00	28.00	70.00
Lime, finishing, hydrated, ton	18.20	22.50	22.00	20.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.50	2.35	1.50	1.50	2.70	2.10	2.80	10.00
Common brick, delivered, 1,000	20.00@21.00	12.00	13.10	11.00	17@19	12.00	15.00	13.00	16.50
Hollow building tile, 4x12x12, per block	Not used	.102	.115	.0724	.0816	.065	.....	.11	.....
Hollow partition tile 4x12x12, per block	.1573	.102	.115	.....	.....	.065	.108	.11	.....
Linseed oil, raw, 5 bbl. lots, gal.	—.98	1.08	—1.14	—1.12	—1.04	1.25	—1.18	.86	1.26
Common Labor:									
Common labor, union, hour	.75	.35	.....	.....	.....	.50@.55	.55	.....	.....
Common labor, non-union, hour	....	.30	.30@.50	.82½	—.50@.55	.35@.50	.50	.50@.62½	+.35@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b.

Labor—Concrete laborers' rate, 93⅜c.; building laborers (pick and shovel men) 75c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.80 for Kelly Island and $1.70 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in iron bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, size 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine lumber. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 97.78). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 3-in., $47.43; 6-in., $119.

Few Price Changes Since Last Week

In the last few months the price changes have been of small consequence. This week lumber and brick are a trifle softer in New York. Linseed oil continues to decline in a number of cities. Steel is down in Montreal. These are local fluctuations that tell nothing significant.

St. Louis unions of bricklayers, according to *Engineering News-Record's* correspondent, have informed the contractors that, effective Nov. 1, 1923, the rate shall be $1.75 per hour—an increase of 25c. At present bricklayers and stone masons are receiving bonuses that with wages amount to about $1.75 per hour. Carpenters were recently granted an increase of 25c., to $1.50.

July building permits in 270 cities aggregated $243,004,821. This is a high normal value for this season of the year and indicates that despite a very high cost level much building is still being planned. The Eastern states report value of permits in July as 23.6 per cent over July, 1922, and a decline of 3.2 per cent from June of this year. Central states showed a very small increase over July a year ago and a still smaller loss from June of this year. Permits in the Southern states fell off about 10 per cent. The Pacific Coast states reported an increase of 42 per cent over last year and a decline of 17.5 per cent from June of the present year.